TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

OCTOBER 1955

The Policeman
Passaic's Parking Lots
California Highway Studies
Regional City Traffic Factors
City Administrators' Role in Traffic
Joint Highway Research Study at Purdue
Promoting Traffic Safety in Indiana
Connecticut's In-Service Schools
Ontario Traffic Engineering
Fortified Traffic Control
Safeguarding Drivers

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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The Policeman

THE policeman is a key figure in our traffic problem. Signals cannot always replace him. Yet obviously not all policemen are fully imbued with the whole purpose and nature of their duties, of their authority, nor with the need to exercise and maintain public courtesy, order, and control.

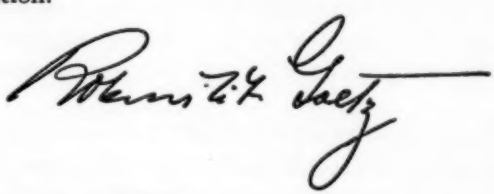
At times the police officer defeats his own purpose by prejudice and partiality. This is an occupational disease. By prejudice in uniform, an official makes himself ineffectual. He arouses the public's disapproval—and loses the public's support.

Notwithstanding these faults, he deserves understanding. Circumstances often place him in a most difficult position, for which he is sometimes neither inherently qualified nor properly instructed. And in his capacity of real responsibility, he is frequently faced with an unresponsive public. These situations are unenviable and at times unfair, both for police and the public.

Now and then an officer is assigned to duty by an authority ignorant of conditions and unqualified to inform him. With every desire and his best conscience to perform his duties properly, the officer is fully aware of an absence of adequate support. So he finds himself in that impossible position of responsibility without authority.

The traffic policeman deals with a public often hostile and unfriendly to his well-meant efforts. Directing traffic is not a simple task. It cannot be properly performed without appropriate instruction. The driving public will not mend its driving or its attitude as long as either scapegoats or "privileged characters" exist in police performance.

Nothing can contribute more to driving safety than realistic, yet uniformly courteous, enforcement of traffic laws and controls—and of helpful traffic direction.



A City Administrator's Responsibility in Traffic and Highway Programs

L. P. COOKINGHAM

Mr. Cookingham has been City Manager of Kansas City for the last fifteen years. He has been engaged in municipal administration for thirty-five years, twenty-eight of which have been in the field of public management. Prior to his assignment in Kansas City, he was the city manager of three cities in Michigan. He is past president of the International City Managers' Association and the American Society of Planning Officials. He was the first individual selected by the LaGuardia Memorial Association of New York to receive the annual award for outstanding achievement in municipal affairs.

PRACTICALLY without exception, the modern city administrator recognizes traffic congestion as one of the most critical problems that face the ever-growing urban area. He knows that free flow of people and goods is essential to preserve the integrity of the central business district, and that the growing toll of vehicular accidents can be curbed only by vast and generally expensive street and highway construction and reconstruction. Thus the city administrator confronts a challenge unparalleled in modern history.

In the last decade cities everywhere have experienced sharp rises in population and even greater increases in automobile traffic as the ratio of automobile ownership to family units increases. For example, between 1946 and 1954, Greater Kansas City experienced an 18 percent population increase, but during the same period motor vehicle registrations increased 68 percent. Some city streets now carry as much as 300 percent more traffic than they did eight years ago. The problem has become so acute that the present federal administration, which generally favors withdrawal from state and local problems, has presented a highway program to spend $101 billion for highways in the next ten years.

Whether the urban street systems designed for a leisurely way of life geared to the horse can be adapted and modified, even replaced, to provide circulation of people throughout the veins and arteries of

our cities depends largely upon the vision and leadership of the city administrators. The cost of traffic delays, needless accidents, and inadequate streets and highways reaches every businessman and every citizen in the community. The future health of our cities depends upon our success in meeting the challenge, in solving the problem that confronts us. And time is running out.

The City Administrator and the Program

Corrective action must be taken on the local level by the city administrator, the local city council, and the citizens of each community. But frequently the problem extends far beyond our unrealistic political boundaries and is regional in scope. This is especially true in metropolitan areas where the central city must assume the leadership and work with other cities and communities in the area to develop an integrated and long-range plan for highway and expressway construction.

In most cases the program will also involve the construction or improvement of state or federal routes and must therefore be coordinated with those government agencies. Citizens look to their city government and city administrator to provide the leadership necessary for formulating and implementing the highway program. In formulating the program, the city administrator has at least five responsibilities to citizens and the local legislative body: (1) to develop a competent technical staff; (2) to formulate a master plan and a capital improvement budget; (3) to cooperate with other units of government and to achieve a high degree of cooperation within the local community; (4) to provide for the relocation of displaced families; and (5) to encourage planning for the urban fringe.

Planning a highway or expressway system is a complex undertaking which must be based on accurate analysis, thoughtful study, and a healthy measure of knowledgeable vision. Before a highway system can be planned, future land use, direction of city and urban growth, and financial abilities of the jurisdiction involved must be carefully determined. For these reasons, the city administrator must first develop a capable, well-trained technical staff he can rely upon to prepare a sound plan of action. Kansas City was one of the first major cities of America to recognize the need for a separate unit

within the city organization to specialize in the unique problems of traffic engineering. In 1930, the division of traffic engineering was created within the public works department, and in recognition of the growing importance of this technical specialty, the traffic engineering function was given full departmental status in 1952.

Similarly, in 1920 the first planning agency was established as a part of the Kansas City government. A low-budget planning program was carried on until 1943. Then, in recognition of the need for extensive and widescale planning to solve the problems brought on by wartime growth and shortages of materials, the budget was greatly increased. The planning staff was assigned the study and development of programs leading to a master plan, the revision of the zoning ordinance, a vigorous attack on blight and slums, continuous capital budgeting, planning for industrial development, and cooperation in regional planning. It was here that Kansas City's present highway and expressway plan had its beginnings. An adequate master plan is the key to the orderly development of any city; without a master plan there can be no unified planning for streets, major thoroughfares, private residential and commercial development or needed public improvements.

The third agency of city government participating directly in the planning of a highway program is the engineering staff headed by the city engineer. Here the detailed construction plans and estimates are prepared from the reports and drawings of the traffic engineers and city planners. Only through the cooperative efforts of all three—the city plan commission and its staff, the traffic department, and the engineering division of the public works department—can realistic plans for solving our traffic ills be converted into concrete and steel answers to the growing demands for more adequate streets and highways.

Master Planning and the Capital Budget

The city administrator must look at the entire physical development of the city and relate it to an estimate of the city's probable financial capacity. To do this he must have the aid of a sound master plan and a realistic capital budget. Each city program must be coordinated with all other programs so as to to provide maximum benefit rather

than conflict—a street and highway program must harmonize with neighborhood preservation, redevelopment, future land uses. Above all, it must be related to the city's ability to finance improvements as well as the necessary everyday services.

Only intensive studies of traffic needs, population trends, and future land uses can form the basis for planning new trafficways, bridges and other similar projects. Origin-destination data must be carefully coordinated with existing and future land use patterns, proposed new public and private developments, and with existing major thoroughfares as well as other forms of transportation. Basic to these studies is the provision of traffic service where needed in such a manner as to preserve residential and neighborhood living qualities. Freeways and expressways should be located to minimize the bisecting of residential neighborhoods and to improve travel time to major places of employment—both to the central business district and to the industrial districts.

Planning and construction of the highway system includes the need to provide terminal facilities. The expeditious movement of vehicles would be of little value if adequate parking facilities are not provided at the end of the trip. In Kansas City studies were made of the need and location of parking facilities in the downtown district. A start toward meeting the demonstrated need is now under way in the form of two large parking projects. The first is the $4 million underground Auditorium Plaza Garage on the west edge of the high value district which is being financed by use of revenue bonds. The other is a six-block redevelopment project at the north edge of the business district which eliminated an area of undesirable business buildings with substandard residential uses on their upper floors.

This project provides an open entrance to the retail district from the expressway loop and an ample parking terminal for customers and employees. Clearance of the land was financed in part by Title I of the Federal Redevelopment Law and in part by local tax abatement as authorized by the Missouri Redevelopment Law. The new facilities are being constructed and financed by downtown business interests which formed a Redevelopment Corporation to develop this particular project.

Other parking terminal facilities are planned in other areas of the central business district, to be constructed as the demand de-

velops. All parking facilities are specifically planned to integrate with the programmed expressway system and with downtown land uses.

Expressway Loop Distributes Traffic

In planning transportation systems, standard engineering techniques are universally recognized. However, it should be understood that only through land planning, effectuated under the police powers of the city in the form of a zoning ordinance and subdivision regulations, can direct control over the peak-load problem on traffic arteries be exerted. Through these tools, some measure of control over the size, intensity, location and type of land use can be effected, thus limiting the location of large traffic generators. In every case proper consideration must be given to economical use of land and the preservation of the city's tax base.

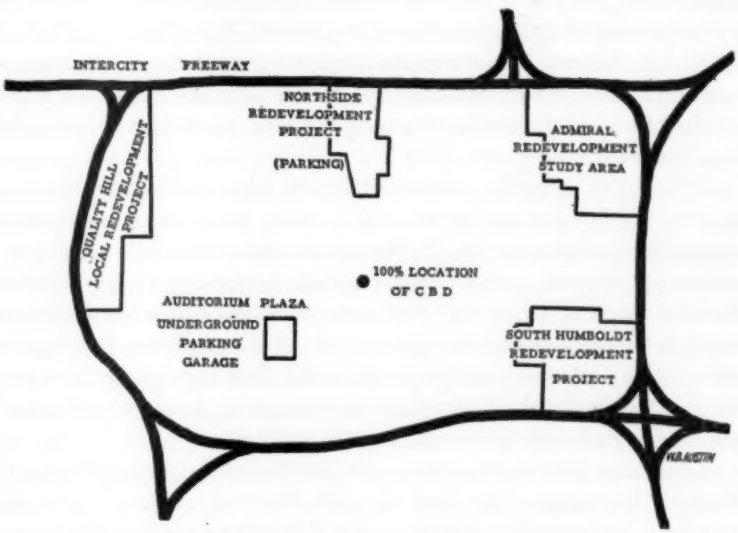


FIGURE 1. Relationship of Central Business District Freeway Loop To Parking Terminals and Redevelopment Projects, Kansas City, Missouri.

The expressway system (Figure 1) now being constructed in Kansas City consists of eight freeways and two expressways totaling

about thirty-four miles in length. The ten projects have been located and designed to serve efficiently the intra-urban and interurban traffic flow and to fit into a logical, unified relationship with other elements of the master plans of both Kansas City, Missouri, and Kansas City, Kansas. The loop around the central business district will act as a distributor and will serve as a bypass for about 40 percent of the traffic now using the downtown streets—traffic which has neither origin nor destination in this intensively developed area.

The central business district loop has special significance to the economy of adjacent areas over and above its traffic features. First, much of the right-of-way traverses obsolete and blighted real estate; eliminating this will have a desirable effect on adjacent property while lessening a conflagration hazard with its fire-break characteristics. Second, the loop acts as a buffer between conflicting types of land uses. As an example, one segment of the loop acts as a psychological and physical barrier between a high-value retail district and a warehouse and light manufacturing district. The blighting effect of the industrial area is thus reduced, and with numerous underpasses and overpasses access between the two is actually improved over conditions which existed on the congested surface streets prior to the improvement.

The relief of traffic congestion in our high-value retail district benefits the citizens and merchants in many ways, some not readily apparent. For instance, Dr. LeMoyne Snyder, eminent pathologist, points out that while the normal carbon monoxide content of the blood is about one percent of its volume, a taxi driver may have as much as 10 percent and the downtown traffic patrolman 15 percent of his blood volume in carbon monoxide. It is easy to see how the shopper can tire and cut short her buying merely because traffic congestion has polluted the air she must breathe.

The value of sound master planning cannot be overemphasized. Without the master plan and the subsidiary expressway plan, developed in cooperation with the major cities of the metropolitan area and state and federal highway agencies, the expressway construction program now under way in Kansas City, including two new major river toll bridges, would not have been possible. Equally important, financial planning and a capital improvement budget provided the basis for voter-approval of bonds totaling over $150 million since

1947. Of this total, $32 million was designated for street, trafficway and boulevard improvements.

All Units of Government Cooperate

In developing an interregional highway system, the state highway department and the Bureau of Public Roads must work closely with the city administrator. Studies by the Missouri Highway Department indicate that only 10 to 15 percent of the traffic on interstate routes at the perimeter of the Kansas City metropolitan area wish to bypass the central core of the city. For that reason, all interstate routes are carried to and skirt the downtown districts of both Kansas City, Missouri, and Kansas City, Kansas.

Additional cooperative effort was called for between the two Kansas Cities which are immediately adjacent to each other and separated only by an invisible state line.

Initially, highway planning had to be coordinated between the two cities and the two state highway departments. Recently the State of Kansas began construction of a toll road system which materially changed the thinking about highway construction in that jurisdiction. New alignments for the toll road terminus at Kansas City, Kansas, will require integration into the plans of Kansas City, Missouri.

Kansas City, Missouri, endeavors to coordinate its plans with those of other cities within the metropolitan area. Prosperity of the central city downtown district is enhanced by easy and quick access by customers from surrounding towns. The state highway department, following the same principle, brings interstate routes close to but not through the Kansas City high-value district. The same routes are located conveniently close to but not through the congested areas of smaller towns, thus preserving their residential areas and shopping districts.

Cooperation Within the City Government

The need for new major traffic arteries within a metropolitan city is apparent, and alignments feasible from an engineering point of view can be readily determined. This has been done for most cities, but

the intricate financial and political task of putting these plans into effect must follow as soon as possible. The program of street improvements and trafficway construction must be kept within the bounds of financial feasibility, for the number of trafficways a city can successfully pay for during a given period is limited. Planning, so essential to sound traffic engineering, must be feasible in both the physical and financial sense.

To assure maximum efficiency in realizing development plans, Kansas City uses a system of interdepartmental committees. Under this system, the city manager appoints an administrative committee of department heads who share the work necessary to obtain sound solutions. The committee presents the results of its collective judgment to the city manager for final review and action.

The use of administrative committees produces continuity in the planning program and provides assurance that one program will not receive ill-advised priority at the expense of other much needed programs. The city council, in turn, is assured that it has a unified program and the best thinking of the administrative staff as a basis for action.

Even more beneficial is the background this procedure gives the council when the program is presented to the voters for their consideration of financing needed to bring plans to the construction stage.

The report on "Expressways, Greater Kansas City" is an outstanding example of the cooperation so essential between city planners and traffic engineers of several governmental jurisdictions. The state highway engineers furnished origin-destination data; the traffic engineers assisted in travel time analyses and supplementary traffic counts; the city plan staff related all data to the master plan for land use, and made studies of population growth and travel habits to predict future needs.

Relocating Displaced Families

One of the more difficult problems the city administrator must face after the planning has been completed and construction is about to begin is the relocation of lower income families, particularly minority group families, who are displaced by freeway construction, redevelopment, parking terminals and similar projects. Any one of

these programs would present difficulty, but when several are proceeding at the time, serious problems of organization and scheduling must be solved lest a part of the program be delayed.

If the problems and fears of families to be displaced are not given top level consideration, they are likely to resort to political action, enlisting the support of freeway opponents, thus making the voting of bonds difficult. In addition, their antagonism may lead to legal controversy which can delay construction schedules and raise costs. The federal government has specified a relocation program as a prerequisite for the grant of funds for urban renewal projects, but it remains for the local administrator to make the system work for highway and local public improvement projects as well. Mere relocation is not enough. Families must be assured that they are not to be moved into areas where they will find overcrowding. The city administrator must guard against accelerating blight as well as moving families into areas from which they again will be displaced by future public projects.

In Kansas City, the primary relocation responsibility for all programs rests with the director of welfare. Through the community service division and family case workers, his office is staffed with trained and capable employees qualified to help the home owner, the low-income renter, and the minority family.

Freeway construction and urban renewal can be used together to advantage in bringing new life into the central city. Kansas City has for several years advocated that redevelopment projects be undertaken adjacent to freeway rights-of-way and that part of the land to be cleared be included in the traffic facility. The Northside Parking Project embodies this principle with the re-use being designated for terminal parking facilities for freeway patrons and for street widenings allowing better access to the central business district.

The freeway program in Kansas City is in part a slum clearance project. Routes now being constructed and others to be constructed have been planned to remove many undesirable and blighted structures. Location of and access to the new routes will encourage conversion of undesirable land uses to more intensive business and industrial uses, and the number of undesirable and substandard structures will be further reduced. It is clearly indicated that a planned system of trafficways, boulevards and freeways carries much greater implications than improved traffic service alone, and all of

these factors must be considered well in advance so that the plan may produce all of the desired results.

Planning in the Urban Fringe

Much attention has been directed toward solving present traffic congestion in the urban areas, but interest has lagged in the planning being done in newly developing areas on the urban fringe. This can be accomplished through cooperation with adjoining governments, and in contiguous areas, through annexation by the major city.

By 1959, Kansas City will have completed annexation of 48 square miles of rapidly urbanizing areas. Planning is now being carried out to prevent many of the problems which would result if these fringe areas were left to develop without guidance and land use control.

Because the newly annexed areas are yet largely undeveloped, it is possible through proper subdivision control to provide a street pattern which will discourage through-traffic on neighborhood streets and to concentrate such traffic on arteries at the edges of new residential areas. It is also possible to obtain rights-of-way for many of the major arteries at the time new subdivisions are platted. Good traffic circulation is stressed but not at the expense of amenities, property values, and the future residents of the areas.

The city administrator, whether he be city manager or mayor, has other responsibilities in the traffic and highway program for his city, but these are of a minor nature. It is incumbent upon the city administrator to develop the objectives of the program, to point the way for the future benefit of the community. In this respect, his responsibilities of leadership are basically the same for this program as for the other municipal improvement programs. Performed efficiently and with vision, this leadership will gain for the citizens to whom he is responsible not only the rapid and safe movement of people and goods, but many other benefits inherent in a broad traffic and highway program.

Traffic Factors in the Regional City

BRENT B. FRIEDLANDER AND EDWARD L. FRIEND

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Mr. Friend, also a Master of City Planning, Yale University, is Senior Planner in the Urban Renewal Section of the City Plan Department, New Haven, Connecticut. He was a member of the Yale group which worked on the Regional City Project.

IN January, 1955, students in the graduate program in City Planning at Yale University undertook the study of a 600-mile-long area along the eastern seaboard of the United States. The study was made for two reasons: first, to determine whether the area, which stretches from Portland, Maine, in the north to Norfolk, Virginia, in the south (Figure 1) could be considered in certain respects as a single urban region; and second, to explore the significance of such a determination for future city and regional planning. Professor Christopher Tunnard, director of the graduate program, and Victor H. Jones, Professor of Political Science at Wesleyan University and Visiting Critic in City Planning directed the study.

Detailed explanation of the factors which seem to establish the validity of treating as a whole the region in question is not the purpose of this article. However, to establish the essential unity and urban character of the area it would be well to mention briefly some of these factors.

One of the first steps was the preparation of a map showing Standard Metropolitan Areas as defined in the 1950 United States Census.[1] This map shows an almost continuous band of contiguous metropolitan areas stretching between Boston and Washington with the only substantial break occurring in eastern Connecticut. This gap

[1] U. S. Bureau of the Census, *Census of Population, 1950.* U. S. Government Printing Office, Washington, D.C. 1951. A Standard Metropolitan Area is defined as a county or group of counties containing at least one city of 50,000 inhabitants or more.

is due to the policy of the Bureau of the Census which, as explained, uses the county as its unit in establishing standard metropolitan areas throughout most of the nation. In New England, however, the Bureau turns to the town, a much smaller geographical unit, and to

FIGURE 1. The Regional City: Shaded Portion Shows Area Studied.

the fact that the cōre of the area goes north at New Haven to Hartford and Springfield before turning east and northeast to Providence, Worcester and Boston.

Maps prepared of urbanized areas,[2] locations of manufacturing

[2] Ibid. An urbanized area contains at least one city with 50,000 inhabitants or more plus the urban fringes of such cities.

plants,[3] and places of residence of workers in manufacturing all show the same concentrations between Boston and Washington with lesser concentrations stretching between Boston and Portland and between Washington and Norfolk.

Natural Boundaries Mark Area

Some of the economic and physical reasons for the boundaries of the area appearing where they do have been given by Richardson Wood, economic consultant.[4] He points out that Chesapeake Bay, with Norfolk at its southern end, is the last of the great northeastern harbor areas, with hundreds of miles of sandbars separating it from the string of southern ports between Wilmington, North Carolina and Jacksonville, Florida. In addition, a significant change in the economic and cultural base starts with cotton cultivation a short distance north of the Virginia-North Carolina border.

To the north, the break occurs north of the Lewiston-Auburn metropolitan area where any significant urban industrialization ends, and the economy of fish and forests extending through the maritime provinces of Canada takes over. This region should perhaps extend as far as Bangor and Penobscot Bay, but because of the long stretch of relatively undeveloped territory between Bangor and Portland-Augusta-Lewiston-Auburn to the south this latter area was chosen as the northern extremity of the region.

When the pattern of population change between 1920 and 1950 is examined the unity and urban character of the region become even more striking. The same continuous band shows the greatest degree of population increase, with adjacent areas showing, on the whole, relatively stable or in some cases even declining population. This follows the general trend throughout the nation where the greatest percentage of increase has occurred within metropolitan areas but outside central cities.

All this indicates that we have a new type of region to deal with —one based not on geographical factors like our major river valleys

[3] U. S. Bureau of the Census, *Census of Manufactures, 1951*. U. S. Government Printing Office, Washington, D. C.

[4] This information was obtained from a talk by Mr. Wood to the students in the Graduate Program in City Planning at Yale University on February 15, 1955.

but on the spheres of immediate influence of a series of interrelated urban centers. This is a concept difficult to grasp; the problems presented by individual metropolitan areas have barely begun to be understood and now we need to think in terms of a complex of interrelated metropolitan areas.

The starting point, therefore, must be to regard the region as an urban whole rather than as a series of cities separated by considerable undeveloped or rural areas. It is true that rural and open stretches do occur, but they are relatively small in size and usually directly tied to nearby cities.

If the series of closely interrelated metropolitan units are regarded as forming an integrated urban whole, then it follows that the area's major road system should be considered an integrated urban pattern. The road system of the entire area then takes on many of the characteristics (on a greatly enlarged scale) of the ordinary urban street pattern.

In general this means that those concepts essential to proper urban traffic planning should also apply to the interurban highways in the region: provision of different types of roads—local, secondary, and major—to handle appropriate types of traffic; treatment of traffic as a function of land use; provision of maximum service, etc.

Handling Interurban Traffic

Before examining these concepts as they apply to the area under study, it would be well to appraise past and current methods of handling interurban traffic.

The oldest and still most prevalent method of handling increased or new traffic loads between municipalities within a metropolitan area or between metropolitan areas is to make ordinary unlimited access roads serve by widening and improving them and where necessary by building new connections or entire new roads. U. S. Route 1 is an excellent example of this type of road. It is the region's major complete highway link connecting the metropolitan areas of Portland, Boston, Providence, coastal Connecticut, New York, northern New Jersey, Trenton, Philadelphia, Wilmington, Baltimore, Washington, and Richmond. It has even been suggested that the area be called "Route 1 City."

Yet this route presents a curiously confused picture. It is a fairly good four-, and even six-lane highway in some open sections and a twisting narrow two-lane road in others; it bypasses some cities, is the main street of others, and in some is a hodgepodge of tortuous back streets. It passes indiscriminately through open country, the commercial centers of cities, industrial areas, fine residential sections, and the worst of industrial, commercial, and residential slums. Consequently it brings about a mixture of all types of traffic—passenger and truck, local and intercity, short haul and long haul—to the degree that in many areas none of them can function properly.

The faults inherent in handling major interurban traffic arteries in this manner are self-evident and well known. Hazards and congestion result from the mixture of too many kinds of traffic, the constant change in width and design standards as the road passes from one local jurisdiction to another, from local to county or state jurisdiction, or from open to built-up area; the prevalence of intersections at grade, and the interference of cars entering and leaving parking places, loading areas, or driveways.

Parkways Add Traffic to Cities

The first break in this pattern, limited access parkways which began in the 1930's, provided an antidote to congestion only along those suburban and rural roads which were part of the interurban network and to a certain extent in those cities which the highways bypassed. Carrying traffic to the outskirts or along the periphery of cities in the region did nothing to help the situation within these cities. In fact, dumping traffic at terminal or intersection points incapable of handling greater volumes only aggravated the situation.

The Westchester County, New York, parkway system, for instance, before the west side and east side highway systems were built in New York City, ended at the border of the city, leaving vehicles to find their way into or through the city on the existing street system. Remnants of this pattern still exist. The bottlenecks along Bruckner Boulevard in the Bronx, for instance, which connects the Hutchinson River Parkway serving eastern Westchester County, with the Franklin Delano Roosevelt Drive on the east side of New York City, are still in the process of being eliminated.

Many of the limited access expressways, carrying both passenger and truck traffic, suffer from the same fault of carrying traffic between cities or between the city and the hinterland while disregarding traffic within the city itself.

When this eastern seaboard region is considered as one interdependent urban complex with the consequent need of an integrated, essentially urban highway system, the deficiency of incomplete highway planning becomes evident. An integrated urban regional highway system, like that of a properly integrated city street system, must provide adequate service for all components of the traffic system. To slight in-city traffic in regional systems is the equivalent of slighting traffic in the congested commercial centers in city street systems.

Neglecting traffic in the urban cores of the region or treating it in the same way as that in outlying areas is clearly fallacious because traffic volumes within a forty-mile radius of the central business districts of the major cities within the region tend to average three to six times the volumes in the rest of the area. (Figure 2.) This indicates that our express highway systems should not only penetrate the cities in the region but should provide for the heavily increased traffic loads in these cities and in the immediately surrounding areas.

A road-building program which would accomplish this end would necessarily involve a great deal of cooperation, in both the planning and financing of highway and street development, among the states in the region, and between the states, counties, and municipalities within their borders. Much more cooperation would be required, at least on the planning level, than at present is evident. How to achieve the necessary cooperative effort is an extremely complicated problem involving the relationship of governmental units and is beyond the scope of this article. It is an important part of the larger problem of the adequacy of the existing governmental system in metropolitan areas—a problem which is receiving an increasing amount of study and which will eventually require solution.

Connecticut Sets a Pattern

The relationship of the Connecticut State Highway Department's current program to the traffic situation within New Haven's city

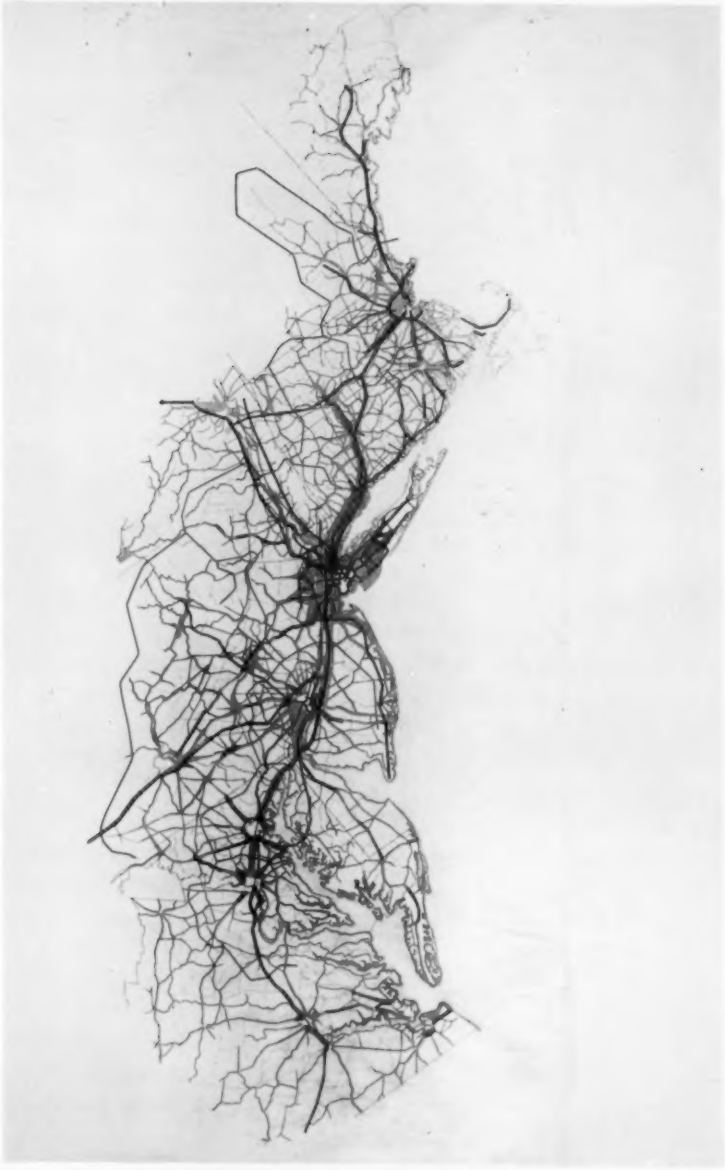


FIGURE 2. Traffic Flow (1950 map.) Volumes in Major City Business Districts Average Three to Six Times That of Outlying Areas.

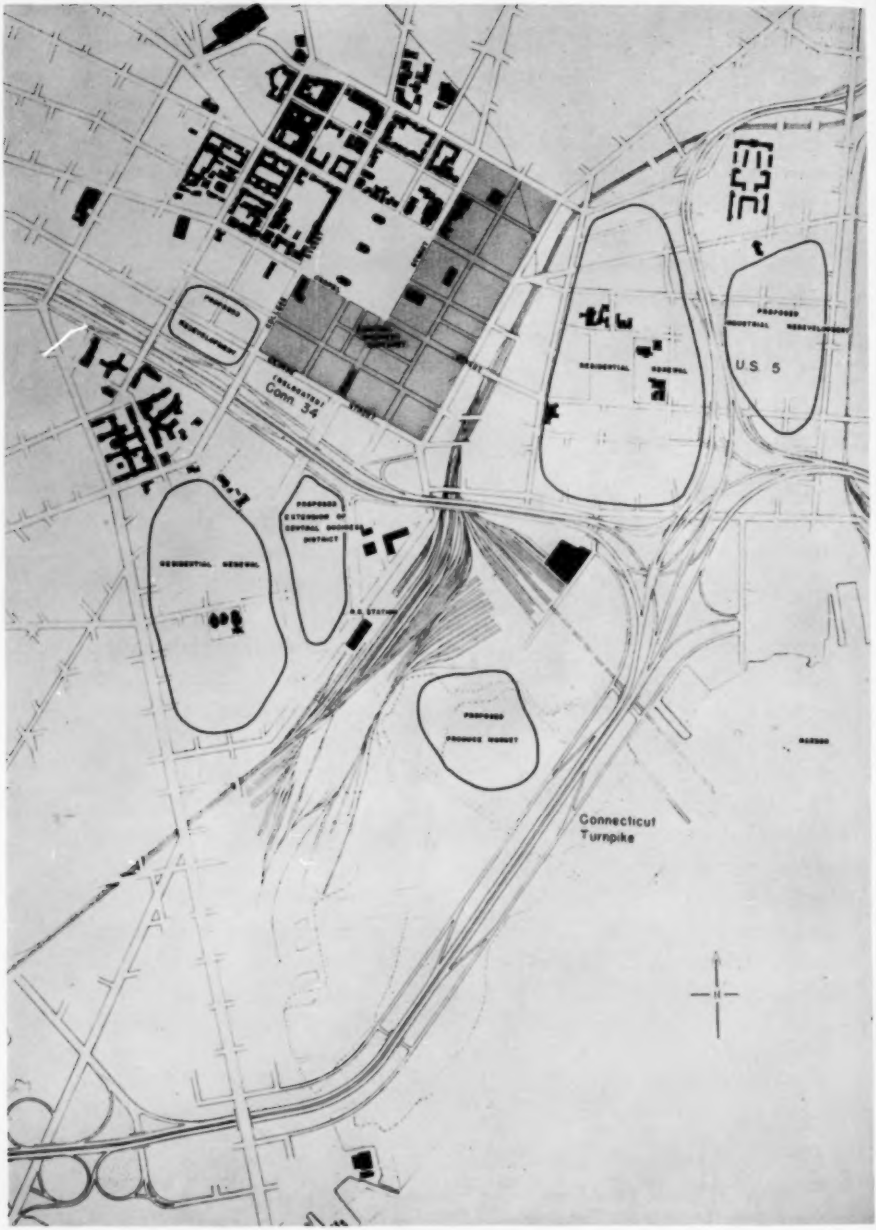


FIGURE 3. The Center of New Haven, Connecticut, Showing State and City Improvements.

limits, and the solutions reached by cooperation between the state highway department and the city should serve to illustrate the direction in which our highway building pattern must move if adequate integrated solutions are to be found to urban and interurban traffic problems within the region.

The basic components of the current state highway department program within the city limits are two limited access facilities, both part of major new expressways: the Connecticut Turnpike, now under construction, designed to replace U. S. Route 1 as the major east-west through-route from New York to Rhode Island, and the relocation of U. S. Route 5, tentatively scheduled. (Figure 3.)

These two new highways will greatly increase the effectiveness of the state's highway system and relieve congestion on those city streets presently parts of Routes 1 and 5. In themselves however, they will do little to aid the flow of traffic within the center of the city. If the program were to stop with the construction of these two new facilities, traffic bound to and from New Haven's central business district would still have to find its way along the city's congested street system.

Realizing this, New Haven's city plan department suggested the inclusion of a limited access road to carry traffic between the intersection of the Connecticut Turnpike and relocated Route 5 and the central business district of the city. After negotiation between city officials and the highway department this road, "Oak Street Connector" (relocation of Connecticut Route 34), was agreed to. This route, which will run just south of the city's central business district, is not only designed to carry traffic between the center of the city and the new state highway system to the east, it will also eventually connect with the Derby Turnpike, an existing high quality state road, and thence to the Wilbur Cross Parkway, part of the parkway system from New York City, to just south of Hartford, connecting with roads to Springfield, Worcester, and Boston.

New Haven's part in improving the traffic circulation pattern is to extend two major arteries, Church Street and College Street, to facilitate movement between Relocated Route 34 and both the central business district and the city's northern residential areas. The extension of Church Street also will provide a long-needed link between the railroad station and the center of the city and will even-

tually provide a secondary link between the Connecticut Turnpike, with which it is to connect, and the city center.

The New Haven traffic solutions also illustrate the way in which the highway pattern can be influenced by and, in turn, can influence land use patterns. The original right-of-way for the relocation of Route 5 proposed by the state highway department was several hundred feet to the west of the present proposed route, thus cutting in two a deteriorating but still pleasant residental area. Consultations between state and city resulted in changing the route to its present location, permitting the retention of an intact residential neighborhood (now slated for rehabilitation under the 1954 Federal Housing Act) to the west of the proposed location of Route 5. The change also creates an area to the east—now composed of a mixture of industrial uses and slum housing—which is ideal for industrial redevelopment situated between the proposed expressway on the west and a spur line of the New Haven railroad and the Mill River on the east.

Location of the Connecticut Turnpike on filled land along the New Haven harbor has made available a considerable amount of new land with easy highway access. Part of this land will be used for establishing a wholesale produce market which will permit the removal of New Haven's wholesale produce dealers from their present location where traffic congestion and lack of proper parking and loading facilities reduce the efficiency of operations. In addition, relocating wholesale dealers will remove a blighting influence from the area and permit its rehabilitation as a residential neighborhood.

The extension of Church Street from the Oak Street Connector to the railroad station and thence to the Connecticut Turnpike is expected to facilitate the extension of the central business district along its east side.

The example of New Haven not only demonstrates how cooperation between state and municipality can achieve a highway development program that both meets interurban needs and increases the efficiency of the traffic network in the urban center; it also illustrates the very direct way in which highway developments influence land-use patterns. Generally the influence of highway changes and improvements on land-use is not so direct, and unfortunately it is rarely so carefully planned. But such influence always makes itself felt for better or worse.

Relating Traffic Facilities to Land-Use

It is, therefore, not only the relation to in-city traffic that should be taken into account in building new highway facilities, but also the relation of these facilities to the entire land-use pattern of the areas through which they pass.

This means of course that transportation planning is an integral part of the total planning process and that highway plans in an area such as the one under consideration must, if they are to achieve maximum success, be coordinated with the other elements of regional and urban planning.

Robert B. Mitchell and Chester Rapkin[5] divide the development of a sound urban highway and related transportation plan into three stages and state that the success of the results in the second and third stages depends largely upon the quality of planning in the first. These stages are:

"1. A major highway and local transportation network for an entire metropolitan area—designed in relation to the general plan of the community. At this stage the design should delineate only in general terms the specific locations and capacity of the various channels. The later stages are intended to detail these aspects of the plan. 2. Specific route analysis and general plans for individual sections, or channels, in the system—this stage must be completed before decisions about financing and construction can be made. 3. A detailed design of highways and other channels of traffic and of improvements in the existing traffic network."

Mitchell and Rapkin go on to state that "the general plan for a metropolitan highway system, as for any element of a comprehensive development plan, is necessarily on a broad scale, without much attention to detail, and somewhat diagrammatic. It deals with major highways—the traffic channels of significance to the total metropolitan community. In subsequent comprehensive plans, the particular elements significant to each section of the city are given more detailed attention."

They then differentiate between the point of view of between-city or into-city traffic which must consider "the entire urban metro-

[5] Mitchell, Robert B. and Rapkin, Chester, *Urban Traffic: A Function of Land Use*, New York, Columbia University Press, 1954.

politan network (as) a terminal system that collects and distributes the long-distance traffic and provides it with terminal facilities," and that of the cities themselves where "the other function of the urban highway network—facilitating movement among parts of the metropolitan area itself—is much more important because of the volume of traffic." The authors state that in urban traffic planning the needs of both kinds of traffic must be taken into account.

Regional Planning Needed

If the thinking developed by Mitchell and Rapkin is extended to encompass the entire region under discussion, it is evident that what is needed is the design, necessarily in general terms, of a major highway system for the area which will tie in both with existing and planned traffic networks in the communities within the region and with other elements of the general plans of both the communities and the region as a whole.

The region's interurban highway network not only affects the organization of land-uses in urban centers; it can also have profound effect upon the economic development and land-use patterns of previously undeveloped or scantily developed sections. Just as other major modes of transportation—rivers, canals, railroads, etc.—greatly affected the development of land during their respective periods of ascendancy, so the automobile has played its part in opening up new areas to development.

Since the majority of the nation's urban centers had been well established by the time the automobile began to enjoy widespread use, the role of automotive highways in this development was somewhat different from that of other transportation arteries. Unlike natural waterways which played an important role in both the original location and subsequent growth of centers, or canals and railroads which were in many instances primary causes of the rapid development of many small communities into important cities, the automotive highways' chief function in this respect has been the physical expansion of already existing urban areas.

In some areas, notably Los Angeles, this expansion took place within the corporate limits of the city; but in most it resulted in the development of residential and industrial suburbs. This suburban

development got its start along railroad lines in the latter part of the nineteenth century. The period following World War I, however, with its considerable increase in automobile ownership and road building saw the first tremendous increase in suburban development. After a period of relative quiescence during the depression and World War II, the rush to the suburbs got under way again when the war ended. At the same time the pressures of congestion in urban centers began to result in an increasing decentralization of industrial and commercial facilities.

New highways, in addition to serving those areas already built up by decentralization from our central cities, also tended to accelerate the rate of decentralization and to encourage new development in their vicinity. B. D. Tallamy, chairman of the New York State Thruway Authority, showed that in the year since the first section of the New York Thruway was opened, an "economic revolution is already underway along the route and especially near the interchanges."[6]

Future Development Important

Although there is comparatively little open land in the region under study there is enough to warrant the taking of considerable care in its future use. In terms of highway planning this means that the potential for future development, as well as present service needs, should be considered in the location and design of new traffic facilities. The old pattern of building new or improving old free-access roads and allowing any kind of development, subject only to the zoning restrictions (where they existed) of municipalities through which the roads passed, clearly is detrimental to both efficient traffic movement and intelligent land-use planning.

Constantly increasing use of limited access highways, with only such facilities as are needed by the motorist permitted along the right-of-way, facilities widely spaced and carefully controlled, constitutes an important beginning in controlling the development and use of land in the vicinity of traffic arteries.

If the effects of highway construction on land-use development

[6] Tallamy, B. D. *Economic Effects of the New York Thruway*. Traffic Quarterly, Volume IX. Number 2, April, 1955.

of the region are to be properly channeled, however, more must be done than controlling the land fronting directly on the highway. The major highway plan for the region should therefore take into consideration development of new land-uses on open land as well as the service of existing uses. Both highway location and design, especially location of intersections, are important in this respect.

It might even be desirable to carry this plan to the point of providing new roads, in the form of ribs off major highways, to open up new land in areas where development is desirable.

The factors mentioned for proper highway planning in the region under consideration all stem from the original concept of the area as an integrated urbanized unit: Recognition of the central role of urban traffic, integration of urban and interurban highway networks, integration of traffic planning with other planning elements, and the relation of highway development to potential future development of open areas. If this concept is correct, proper development of traffic facilities demands a higher degree of planning and integration than is currently practiced.

Promoting Traffic Safety in Indiana

HALLIE L. MYERS

Mr. Myers is Executive Director of the Indiana Traffic Safety Foundation. An associate member of I.T.E., he has broad experience in various phases of traffic safety, serving as chief of the driver licensing division, Indiana Bureau of Motor Vehicles; director of the Bureau of Traffic Engineering, State Highway Commission of Indiana; Chief of Highway Operations, Seventh Zone U. S. Army Transportation Corps; director of Safety and Training and general superintendent of Transportation, Indianapolis Transit Company. He served two years as general chairman of the transit section, National Safety Council and three years as member of the Council's board of directors.

HAD this article been written twenty years ago it would have stated positively that the three E's—engineering, education and enforcement—constitute the answer to the traffic safety problem. Since that time, observation of their fighting many losing battles with the three P's—pressure, prejudice and politics—has considerably shaken my faith in the three E's as a cure-all. Like the boy in Mark Twain's story, who ran away from home because his father was ignorant, obstinate and opinionated, and returned three years later to be amazed at how much the old man had learned in three years, I am amazed at the number of things I knew twenty years ago that aren't true now and probably never were. While still of the opinion that the three E's are an essential part of the correct approach, I have learned that they are not enough. We also need research, planning, adminstration, legislation, adjudication and financing, to name only a few. Above all, we need continuity in policy-making positions of competent personnel.

It would be a waste of time to rehearse here the Genesis of our traffic problem, how it grew and is still growing. We are much more concerned with Exodus—getting out of it, rather than how we got into it.

In the last twenty years Indiana has averaged 1119 traffic fatalities per year. During that time Indiana's fatality rate has shrunk from 16.0 to 6.2 per hundred million miles of travel. This tremendous

rate reduction proves the worth of the three E's but the annual toll of more than 1100 traffic deaths over the same period also proves that the E's are not the complete answer.

Since we have been unable to cut fatality totals much below the 20-year average (1954 was about 4 percent lower) it seems only prudent to examine our methods to see what we are failing to do or what we are doing wrong.

Analyzing Indiana's Traffic Problems

A brief review of Indiana's traffic situation as it exists today shows about 90,000 miles of roads and streets in various stages of improvement; they carry almost two million motor vehicles of Hoosier registry in various states of repair, driven by more than two million licensed Indiana drivers of various degrees of skill, judgment and sobriety. These highways, vehicles and driver licensing are administered and controlled by several thousands of elected and appointed officials of state, county and city government, who are an average cross section of our population, people of varying degrees of preparation, capability and enthusiasm—and, to complicate things, we change many of them every four years and throw away the results of their experience.

We have also in Indiana more than one hundred state-wide organizations of civic-minded, sincere people, each carrying on its own traffic safety promotion effiort; none attempting a full scale program, very few with any continuity of program, and nearly all without any effort at coordination with each other.

Is it any wonder there is a problem?

Roads are an important factor in accidents. In spite of the marvelous strides in modernizing our roads, road builders have always been under pressure and are never quite able to catch up. Thousands of road hazards remain to be remedied. Engineering can do and has done a wonderful job in providing better streets and highways and in removing or marking hazards, but the traffic safety problem will never be solved on the drafting boards of road engineers.

Vehicle manufacturers have done an excellent job, equally as good as the road builders. It seems at times they have done too good

a job; they outstrip the capacity of both roads and people. However, when vehicle manufacturers concentrate on building cars with doors that do not fly open at the first slight impact; dashes and interiors without buttons and knobs that rip, tear and puncture; bumpers and steering columns that will absorb part of the crash force; crash pads and passenger barriers, instead of the eternal race for more horsepower, we will have fewer casualties.

At our present rate it is probable that at least half of our motor vehicles will be in a serious crash within their life span. Since this condition exists, why are vehicles not built to absorb more of these forces? The argument that more horsepower enables us to sprint out of danger overlooks those thus encouraged to sprint into danger.

Horsepower as an Accident Factor

The Indiana record of the past three years shows some evidence of uncontrolled horsepower. In the state as a whole accidents in which the car left the roadway before the crash—most of which result from speed too fast for conditions—accounted for 11.9 percent of all accidents in 1952; 12.5 percent in 1953 and 13.6 percent in 1954. Fatalities from such accidents were 22.1 percent, 24.6 percent and 28.7 percent for the same years.

Another aspect of too much use of horsepower shows up in accidents on county roads where surfaces, width, alignment and signing are not up to state highway standards. All accidents on county roads, which in 1952 were 7.9 percent of the state total, were 9.6 percent in 1953 and 10.9 percent in 1954. Fatalities from these accidents in the same years were 13.9 percent; 15.3 percent and 18.0 percent respectively. This alarming shift in location should act as a spur to county road officials.

It might be said that more horsepower makes good drivers better and poor drivers worse.

Much accent on ease of stopping with power brakes has made thousands believe that nature's laws of force and motion have been repealed and that vehicles thus equipped can be stopped much more quickly. An unqualified statement heard recently on a car manufacturer's telecast that "Brakes are 20 percent more efficient" can easily lead many to believe they can stop in 20 percent less distance.

This of course is not a fault of the vehicle manufacture; rather it would seem to be a fault of the manufacturer in not making a clear distinction between more efficient brakes and shorter braking distance.

Solving the Problem—with People

While much remains to be done in building more safety into cars, the traffic safety program, when solved, will not be solved on the drafting boards of car design engineers.

Enforcement officers are doing a remarkable job of apprehending and convicting flagrant violators but the traffic safety problem will never be solved by police and judges.

Education, too, is vitally important in teaching everyone safe practices, the law, and the results of unsafe action as well as in the training of new drivers. But the traffic safety problem will never be solved by education or educators.

Neither will it be solved by a combination of all three forcefully applied at the same time. When the problem is solved it will be solved in the hearts of men—by the addition of a priceless fourth ingredient appealing to and bringing out the best that is in them. Call it evangelism, inspiration, missionary zeal, leadership or what you will, it is the ingredient that must be supplied by public support groups. It can only be supplied by sincere dedicated people who care enough about the welfare of their fellowmen to do something about it; who have the courage to take a stand and to advertise that stand to the rest of their community and who will by precept and example lead men to a better way of life.

People are of course the biggest factor in accidents. I am talking about people and not restricting it to drivers. We are the people. Each of us has many short-comings. No one fully understands what makes people act like people and, sadly enough, few of us in traffic safety work have tried to learn. Instead we blame the other driver, often rudely. Maybe there is something wrong with us.

The people are our drivers, too. Over two million are licensed to drive in Indiana. These people have not been fully and properly informed about our traffic problem. Everyone has his theory about one facet of the problem but what we need is more general knowledge about the whole problem. Maybe we are confusing them more

than we are helping them. We certainly need an informed and orderly approach.

How, then, can we start to clear up this confusion?

We must start with the assumption that no one in possession of his senses really chooses to, or wants to have an accident. Persons either want to know, or they think they already know, how to drive safely. The greatest trouble with people is that they do not take an adult view of the problem and their part in it; and they will not, or cannot, look objectively at their own failures.

To get an orderly approach requires a high degree of leadership but more than that it calls for a high degree of followership. A general can't win a battle or even have a parade without an army behind him. We need followers too, but we can't draft them. We can only persuade them and before we can do that we must gain their respect. Respect can never be commanded or enforced, it must be earned. It will never be earned by adopting a holier-than-thou attitude and blaming the other driver. We must recognize our own faults and realize that all people have them. Of course drivers make stupid mistakes. We are all drivers; therefore we make stupid mistakes, too.

Administrative Errors Cause Confusion

Often, engineering improvements are made without following or preceding them with information to the public how best to use them. New regulations are made but police do not follow up with enforcement. New drivers are required to learn and pass an examination on sign colors and shapes, only to come upon square stop signs, round slow signs and octagonal speed limit signs. Plans for removing or correcting hazards are carefully worked out only to find the money lacking—due to lack of financing or budgeting.

Education is attempted by some who haven't kept abreast of changing conditions; statistics kept by police do not afford information sorely needed for engineering or education. At least one instance was reported last year of state highway workers' taking down speed zone signs to grade road shoulders; state police arrested, and a justice of the peace convicted a driver of disobeying signs that weren't there. One reads of a driver-examiner losing his license for drunken driving; of highway personnel fined for disregarding their

own speed zones; policemen killed while violating traffic laws; a city safety council president arrested for drunken driving; a city school superintendent flatly refusing to permit at-the-wheel driver training in his city's schools, and so on.

Is it any wonder that we have too few followers? All of this points to the need for coordination of safety activities so that we may earn the respect of those we would make followers.

For many years we have been telling the people what we thought they wanted to hear instead of giving them the whole truth. In the press, in speeches, and on the air we have urged the idea that most of our accidents are caused by drunken drivers, morons, speed demons, hot rods, and road-hogs. Our audiences nodded their heads in agreement and our teaching and preaching went in one ear and out the other because they did not fit into any of these ill-sounding categories. But the plain, inescapable fact is that nice people have accidents, too, and cause them. Daily in Indiana many of our accidents—that occur at the rate of one every six minutes—involve those whom we call our best people: doctors, teachers, preachers, farmers, business executives, housewives, lawyers, insurance agents, public officials.

These people didn't want to kill anyone or injure themselves or others. They didn't want to have an accident. They didn't mean to break the law. Perhaps they didn't break a law since not all safe driving practices are written into law. But at the moment they somehow didn't see, didn't hear, didn't think, didn't know or didn't care enough to do their very best.

There must always be enforcement. A criminal, lawless, reckless element exists that must be restrained but we can't arrest all of these law-abiding people, throw them in jail, or take away their driving privilege. If we could take off the road every person involved in a reportable accident last year it wouldn't solve the problem. Attitudes cannot be changed by punishment.

Misleading Facts Need Clarifying

This brings up another bit of misleading information we have heard for many years—that about 10 percent of the drivers have nearly all the accidents. This is statistically true for any given year

and makes the problem sound ridiculously simple: just take them off the road and solve the problem. What we have failed to recognize is that it is largely a different ten percent each year. Remove every driver who had an accident last year and this year about the same number of people will have about the same number of accidents.

This would indicate that having accidents is purely a matter of chance or luck. It *is* true that if we do certain things the element of chance assures our having accidents according to the law of averages. However, as we remove the things that cause accidents the chances diminish and it is possible for any individual to avoid accidents entirely. This puts it squarely up to each person whether he wants to avoid them badly enough to do something about it.

While engaged in fleet safety supervision with large numbers of drivers, all of whom had the same training and very close to the same skills, I could forecast on January 1st with remarkable accuracy *how many* drivers would go the entire year without accident, and be at least 75 percent correct on *who* they would be.

This was not second sight. The prediction was based on what we knew about each individual—his attitude, experience, judgment and how well he had banished accident causes from his driving habits. If we could know every driver in the state as well, we could foretell with some degree of accuracy who will have accidents this year.

It has always seemed to me an unusual circumstance that, in spite of all the evidence to the contrary, I have never heard any driver admit that he drives poorly. Yet ten out of every hundred will have an accident this year.

If we have an accident the first thing we do is try to prove it was entirely the fault of the other driver—who is just as diligently trying to blame us. If we discuss our accident at all, we prefer a friend who can be relied upon to sympathize with our story. We give only the facts in our favor, coloring them a little, and are careful to build up the other person's mistakes. Finally, feeling secure in this un-biased opinion we exonerate ourselves of all blame. Unfortunately for us, judges and juries don't always accept our friend's opinion and we begin to believe justice is blind. The tragic thing is that no one will look objectively at himself, and admit his mistakes.

Arguments are futile over who are the best drivers, who are the worst or whether men are better drivers than women. There are

competent drivers in both sexes and of all ages and some very poor ones, but generally speaking none of them is a good driver all the time. Some of the best make stupid mistakes. Some who are first-rate in most of their driving have unsafe habits which they fail to recognize as unsafe. They get by for years, perhaps, making the same mistakes until one day it is suddenly and finally too late to learn.

All Drivers Make Mistakes

There is not a driver anywhere who sometimes does not make stupid mistakes in driving. Everyone has experienced embarrassment over realizing a foolish error and looking around quickly in the hope no one he knows saw him do it. Most of us have driving faults we don't recognize as faults, mainly because we have always driven that way. Multiply this by more than two million drivers in Indiana alone and we begin to wonder—not that 150,000 have accidents to report each year but that 1,850,000 do not have.

Another major fault is that many look on driving as a matter of skill alone. Really, only a small group fails to develop driving skill in a short time. Having developed some skill one feels he has learned to drive and stops trying to learn. In addition to skill we need good habits, judgment (which comes from knowledge plus experience) and a good safety attitude.

One disappointment of workers in traffic safety is the indifference to this problem shown by religious leaders. It is rare indeed to hear any priest, minister, or rabbi mention traffic safety to his congregation. It is even more rare to hear of one taking an active part in an organized safety movement.

I know of no religion that does not in its tenets oppose the things that contribute so greatly to the individual's tendency to accidents—pride, arrogance, selfishness, intemperance, disregard of the welfare of others, anger, dishonesty and lawlessness. It is difficult to understand why religious leaders overlook the opportunity to tie these vices into the results all around them.

With all of these parts of the problem before us—what can we do about it?

How can each one of us become better drivers?

First, some way must be found to persuade everyone to adopt a

realistic attitude toward speed. We Americans pride ourselves on our common sense, yet nothing could be less realistic than our attitude toward speed.

All except the fortunate few who have already attained this realistic attitude fall into one of three groups of drivers. Depending on which of the groups we are in we blame all of our traffic troubles on the others.

At the top a relatively small group habitually drives at excessive speeds regardless of conditions. They spend most of their time blaming slow drivers.

At the other extreme are the self-righteous because they always travel at a much slower pace than the rest of the traffic and maintain that speed no matter what the circumstances. They are so complacent and sometimes obstinate about their own so-called safe speed that it is almost impossible to move them from their pinnacle of self-righteousness. Yet a slow car that creates excessive passing can be just as deadly as an extremely fast one causing the same disturbance in the traffic stream.

In between these two extremes the vast majority of drivers drive according to time rather than conditions. It should be obvious to anyone that conditions of weather, road, traffic, vehicle, and the driver's own physical or mental state should determine the speed.

Ways to Solve the Problem

To develop a rational speed policy, these things should certainly be incorporated:

Driving within the range of headlights at night.

Driving by speed signs and speedometer in cities and towns.

On highways if many cars are passing, our speed is too slow; if we are passing many, it is too fast.

We must adjust our speed to the tempo of the highway. In modern traffic it is a short step indeed from pave-stone to grave-stone.

We must do away with the double standard in traffic safety. Too many of us feel that traffic laws are good—for the other drivers; that there is need for speed limits—if they are enforced against someone else; that no one else should sneak on a red light or fail to make a

full stop at stop signs; but if we do it, it is done with the utmost wisdom and endangers no one. Of course, the annual traffic toll proves that in thousands of cases we were to blame and did not use care, wisdom and good judgment.

Nine-Point Program Produces Results

We cannot and will not solve our problem as long as doctor, judge or merchant drives home from the country club after a dozen drinks and yet demands the life blood of a factory- or office-worker who has an accident driving home from a tavern. Passing strict laws and refusing to apply these penalties when a specific case arises will not solve the traffic problem. If the speed limit is 30 M.P.H. it should be that for everyone. If the law is wrong in one case it should be repealed; it is equally wrong for everyone else. The blame does not all belong on the driver. Sometimes juries will not convict, lawyers postpone cases and take changes of venue until witnesses are gone or the case is forgotten. Truly the problem when finally solved must be solved in the hearts of men.

In organized effort we might profit from the example of large commercial fleets which have made more consistent gains in traffic safety than any other group of people. The operators of these fleets realized long ago that they must reduce traffic accidents or be forced out of business. For many of them the cost of traffic accidents was greater than the profit realized from the combined efforts of their entire personnel. They had to do something about it. As these companies worked on the problem a well balanced program emerged—a nine-point program of positive action that produced results:

1. A clear cut set of rules for safe operation.
2. Careful selection of drivers.
3. Thorough training.
4. Good sets of accident records.
5. Close supervision.
6. Removal of hazards.
7. Good vehicle maintenance.
8. Recognition and awards.
9. Penalties.

It is interesting to note that penalties come after other means have been exhausted. This is quite different from much of our public safety effort wherein we pass laws and then jump the seven intermediate steps and start arresting people.

There is nothing new or secret about this program of the fleet operators. It closely parallels the efforts of official programs. But we have been weak on seven intermediate points.

We must first reach everyone with the necessary information, presented so it will be easily understood and voluntarily used in developing the two things that cannot be taught—judgment and good attitude.

Judgment is developed from knowledge plus experience. We must be sure that each person receives the proper knowledge of laws and safe practices and so far as possible reach them with the combined experience of others so that they need not learn safety by accident.

Good attitude requires:

A sincere desire to improve.
Acceptance of individual responsibility.
Acceptance of the fact that all drivers have and acquire faults.
Willingness to look objectively at our own faults.
Willingness to accept instruction.

As each person is reached, his example becomes a strong influence in developing the same attitude in others.

Long experience in dealing with drivers teaches that we don't change them by name-calling, fault-finding, fear of injury or arrests. It is done by a long, hard process of:

1. Earning their confidence.
2. Giving them constructive information.
3. Showing them the benefits of the right way.
4. Appealing to their desire for praise and recognition.
5. Convincing them that driving is made up of knowing and obeying laws; knowledge of safe practices; skill; judgment; common sense, and good citizenship.

Thus, through the individual, we build the community effort for safety. The proper safety climate for our state will come from a

lot of people with a good safety attitude and the others catching it from them. Many persons in cities without a traffic fatality for many years believe their part of the safety problem of Indiana is all taken care of. It isn't. We have to keep it that way—and beyond the confines of our city limits lies a responsibility as good citizens to do what we can for the rest of the state. We travel all over the state.

Often one wants to do something about it but asks himself what can one person or a small group do? Individual effort looks feeble and of little consequence. That is one of the reasons for the Indiana Traffic Safety Foundation.

Indiana Traffic Safety Foundation

Early last year a small group of interested businessmen, seeing the terrific impact of our annual traffic toll on our daily lives, resolved to do something more than talk about it. Realizing the futility of individual effort alone, they sought to do collectively what they could not do singly. The result was the Indiana Traffic Safety Foundation.

The objectives of the Foundation are: to foster and promote the mutual interests of public, business, industrial, labor, agricultural, educational and civic organizations in the safe and efficient use of the motor vehicle on streets and highways.

The Foundation is the only non-political, full-time, traffic safety organization in the state. It derives its major support from large contributions of business and industry. Individual memberships at two dollars a year afford an opportunity for anyone in the state to become a part of an organized state-wide program.

A bi-monthly publication to our members gives accurate, reliable information concerning plans, programs and progress of traffic safety in Indiana. Very soon this publication will go to every student in high school driver-training classes in Indiana to get state-wide coverage.

The aim is to promote and participate in research into traffic accident causes and to develop remedial measures;

To promote safety contests and provide suitable awards;

To carry on, through the various publicity media, a continuing program of public education. At least 138 newspapers in 62 counties of the state are using our material regularly. It is used by many

broadcasting companies and dozens of trade and industrial publications. Thus we reach each month a very large segment of Indiana's four million people.

The Foundation is handling for the National Safety Council their annual Traffic Safety Inventory for Indiana cities. The inventory is not perfect but it provides a means of measuring accomplishment of many things essential to a good safety climate. The Foundation gives awards to the leading cities in each population group.

Every effort is being made to extend driver training at-the-wheel to all of our high schools.

Assisting local communities to form their own traffic safety groups stems from realizing that the state problem is composed of hundreds of community problems and its solution must include effort in every community.

Continual work to coordinate unofficial groups into a unified program indicates no desire to destroy the identity or the initiative of the participating group but as far as possible to help guide their efforts into a state-wide action plan.

Finally it is our hope that the Foundation may be maintained as a strong force to carry on programs during political changes in leadership that cause up-heavals in traffic safety personnel and policies.

Safety Is Everybody's Problem

The State Office of Traffic Safety has done and is doing a tremendous job of coordinating official activities. Indiana's official program is recognized as the nation's best. The Foundation works as closely as possible with them. It is our hope that we will in time get unofficial activities coordinated as well. Everyone realizes now the the two separate spheres of responsibility for traffic safety— official and unofficial. Both have their limitations and both must work together before the job can be correctly done.

The following forms the basic philosophy of the Indiana Traffic Safety Foundation:

1. The traffic safety problem is not essentially a state problem but a collection of dozens of community problems. It must be solved at the community level.

2. The three E's while extremely valuable, are not enough to solve the problem. The answer lies in the hearts of men.

3. Bringing out the best that is in our people is not an official function. It can best be done by public support groups.

4. Business, industry, and civic groups can do a much better job collectively than singly. They must supply the funds and leadership.

5. Coordination and continuity of effort are fundamentals. Assured continuity can only be assured by a strong unofficial, nonpolitical, privately financed group.

6. The story must be brought home to *every* driver that he is not always a good driver; that he makes many stupid mistakes; that just one of these mistakes is enough to kill him; that safety rules apply to him, too, and that if each accepts his individual share of the responsibility the task will be easy.

Financing Passaic's Parking Lots

LEONARD HANAUER

Mr. Hanauer, in the municipal bond business since 1932, is Financial Adviser and Banker to the Parking Authority of Passaic, New Jersey, and holds the same position for Perth Amboy, N. J. He also served as Financial Adviser to the Linden-Roselle Sewerage Authority and to the Paterson, N. J. Parking Authority. He formed the municipal bond firm of Ryan, Hanauer and Company in 1951.

THE initiation of an off-street parking program in Passaic, New Jersey, faced the same problems that have plagued every community of size in this country. The fact that Passaic has one of the largest retail per capita sales volumes in the nation make its problems worthy of review. More pertinent may be the fact that this off-street financing program was solved without a penny of municipal aid—by way of gift or pledge of revenue or credit.

Passaic is situated in the southeastern part of Passaic County. On the east, parts of Bergen County border it; on the south, Essex County. This strategic location brings the residents of thirteen communities into Passaic's central business district almost daily. Its 1950 population was 57,851, and the city has total retail sales of more than $100,000,000.

Retail selling space, 39 percent of the central business district, totals 1,062,000 square feet. Of the 5,796 persons employed in the district, only 24 percent live in Passaic. Another 26 percent live in adjacent Clifton and the rest come from fifty-six other towns, including New York City. Fifty percent of these employees come to work by car. To this basic need for car spaces, add the everyday flow of shoppers to the wide range of national chain and local shops, and the problems become understandable.

While the central business districts of Milwaukee and Detroit account for about 13 percent of total valuations of those cities, in Passaic the values account for 20 percent. This district has but 5 percent of the land area, but the assessed valuation of it is 45 percent of the city's total. In actual figures, land assessments are 7.3 million,

improvements 6.7 million. The ratio of assessments to true values runs about 40 percent, indicating actual values of 35 million dollars.

New Jersey's Parking Authority Law

Recognition of the acuteness of the parking problem more than ten years ago resulted in the usual pattern of blind alleys. The post-war trend to suburban living, highway stores and shopping centers was aimed at the great metropolitan areas and included Passaic, which is in the Greater New York City Metropolitan sphere. Agitation by the merchant group (local chamber of commerce) and its committee on parking met with the customary deaf ear of the city government. Fortunately, New Jersey adopted a Parking Authorities Law in 1948 and Passaic was one of the first cities to organize under this Act. Such action was taken by the city as buck-passing to the Merchants Association, who up to this time received no visible support from the city and had been able to acquire and operate only a few individual lots for the use of specific store owners.

Organization under the act consists principally of an ordinance creating a parking authority and appointing to this authority five non-salaried members with terms of one to five years. The city appointed five active, outstanding business leaders, who still serve as the Parking Authority of Passaic. For the record, the members are: Gilbert Bogart, chairman, Al Levine, Charles Prescott, Walter Dietze and Mrs. Ida Friedman.

The Authority employed William Gurtman as its counsel and secretary, and the Passaic-Bergen Planning Association was brought in to assist in developing a plan and program. This group, now known as the Passaic Valley Citizens Planning Association, has rendered invaluable assistance to the Authority. Acknowledgment is hereby given for much of the statistical data included in this article. The data were developed by this group, a non-profit organization devoted to assisting the communities of the area on all civic problems. The Association developed all of the necessary charts and data of needs for space, available space for parking, desirable locations and feasibility findings. Late in 1949 the author was employed as financial advisor and a nationally known engineering firm was engaged to develop a final program.

The financing phase was reached in September of 1950 with a program calling for the issuance of $670,000 (since increased to $750,000 for completion) of bonds. These bonds are payable, both interest and principal, solely from revenues derived from "off-street" lots, after payment of operating costs. The initial bonds bore interest at 3¼ percent, a low cost due primarily to the favorable bond market of that period. The additional bonds, totaling $80,000, were sold in 1954 at a 4 percent rate.

Costly Experience in Financing

This costly interest experience could have been avoided and the causes may serve as an example of avoidable pitfalls to other communities. Initial financing was based on estimates for acquisition of the three sites, including the costs of land, demolition of buildings and drainage paving and financing costs. The only item not accurately estimated was land (improved). With the assistance of two local realtors, the engineers computed land costs at a maximum of three and one half times valuations (on the average) versus assessment based on 40 percent of true values. Many small parcels were acquired at from 75 percent to 100 percent of the Authority's allowable figures.

Refusal to sell by a good many holders caused the Authority to use condemnation procedure. The awards were high and in most cases favored the sellers with the result that the Authority ran short of funds. In one case, the award was so very high as to necessitate a revision of design and a by-passing of the property involved. This fortunately did not materially alter the lot layout. These factors were the reason the Authority had to borrow an additional $80,000 four years after the initial bond offering, entering a relatively high interest cost market for parking bonds.

Ways to Avoid 'Running Short'

One way to avoid this would be to obtain options on all property involved. Accurate cost estimates can be made by experienced engineers and funds sufficient to meet all outlays can be borrowed initially. Another method may be to have the municipality acquire by purchase or condemnation all property and then turn it over

to the Authority when the latter receives its funds from a bond sale. The best and possibly most inexpensive method, which allows for study and review, would depend on a loan or grant to the Authority. As an Authority is created with nothing but title, such funds should be lent by the municipality to assist in the exploratory work. Working funds permit for a complete survey by recognized parking experts in the engineering field. This would develop best locations, anticipated rates and gross revenues and conclusions as to the permissible debt load, thereby creating an outside cost factor for land.

With funds in hand, an Authority could proceed to acquire options even at nominal costs. It could also bring condemnation hearings to a point of award that would allow for the needed time to make careful study of actual figures. Thus, by revision, if necessary, all properties would be under option and final financing costs would be determined. Actual over-all cost per car stall in terms of bonds to be issued versus revenues to be anticipated is the investment factor to the bond buyer. As this can vary widely, dependent on the locality, there is no set rule to apply. For example, the cost per car stall in New York City could well be $3,000 or more but rates charged would be from 75 cents for the first hour to one dollar and fifty cents per day and higher. Passaic with a per car stall cost of about $1,350, charges 25 cents for the first hour and 35 cents to 50 cents for a full day.

Generating Power

The Passaic experience proves the value of the "generating power" of new facilities.

Engineers' estimates, so important for placing bonds with invest-highway or parking lot, in terms of generating business. This, in the case of the Parking Authority of Passaic, is proved best by the figures of parking meter receipts as attested by the records of Passaic. In 1951 the gross income from all "on-street" meters was $46,860. In 1952 (parking lots commenced operation in May) the income was $47,807. In 1953 the income was $42,978 and in 1954, $43,764 was collected from street meters. In this period the Parking Authority showed gross income of $27,711.90 for 1952 (7½ months), $59,-235.05 for 1953 and $76,096.00 for 1954.

Engineers' estimates, so important for placing bonds with invest-

ors, anticipated growth but actual experience proved them conservative. These estimates versus actual gross income were:

	Estimated	*Actual*
1952 (7½ months) . .	$20,900.	$27,712.
1953	47,800.	59,235.
1954	53,200.	76,096.
1955	57,300. (full year)	38,664. (to July 3)

Expenses have been well in line with the engineers' estimates, as a strict budget is observed.

From a financial standpoint, the Authority has proved sound. Actual funds in the Debt Service Reserve Account as of June 30, 1955 totaled $17,000 (invested in Series K, U. S. Treasury bonds), versus $8,000 required by the Bond Indenture. In addition, there is $2,000.02 in the Operating Reserve Fund, which is up to the schedule required. Average revenue in 1955 has exceeded 1954 by approximately 8 percent. The free balance in the Revenue Fund on June 30, 1955 was over $7,500, indicating that on December 31, 1955 approximately $15,000 will be added to Debt Service Reserve Fund, bringing this total at year-end to $32,000.

Much trial-and-error was encountered by the Parking Authority from attendants to uniforms, lighting, public sentiment, merchants' complaints and even problems arising from the trust agreement with the bondholders. With virtually no experience to draw on and forced to blaze a trail in New Jersey, the record is enviable.

Through a miscalculation, it was found that the trust agreement required the building of an Operating Reserve Fund equal to three months of anticipated costs before setting aside money for interest. The Authority did not need this working balance so long as it had one month's (one-twelfth of annual budget) on hand. It was by a close margin that default of interest was avoided on January 1, 1953, despite the unemployed balance in this Operating Reserve Fund. Other minor technical details became apparent in the trust agreement, but have not worked any hardship on the Authority. This document, most necessary and important to bondholders, must be written and understood in every detail.

In problems of management, this Authority has been most fortunate. William Gurtman, after great assistance in the launching

and financing of the initial bond issue and supervision of all title acquisitions and numerous problems of public relations, was appointed city counsel. He was succeeded as authority counsel by Carl Nitto who was also made general manager. Mr. Nitto has handled all matters of employees, city liaison, and merchants groups with dispatch. Today the operations are smooth and the Authority meets as a well organized board of directors to deal with important matters, sans trivia.

The local newspaper, the Passaic Herald News and its editor, Harry Adzit, were most helpful to the Authority from the outset. Numerous articles and editorials roused the city officials to the need for solving the parking problem. News of progress kept public interest alive and pictures and front page articles of the dedication ceremonies of each lot, along with slogans, were of great assistance in acquainting the motorists with locations. This paper, with a circulation of approximately 64,000, for a city of a population of 57,851, has one of the widest circulations of surrounding communities to be found, further proving the vital business center that is embraced in Passaic.

One of the greatest boosts to the success of this undertaking was the cooperation and sponsorship of the merchants group of Passaic. Thousands of dollars were spent in advertising and circularizing in Passaic and neighboring communities to acquaint the public with the location of the car parks. Even at this time, funds are still expended by this group in newspaper ads, such as the copy included in this article, which appeared in the Passaic Herald News on June 8, 1955. In addition, the merchants entered into an agreement with the Authority to give virtually free parking to all shoppers. The initial step in this direction was unique and was certainly responsible to a great degree for the favorable reception given the car parks by the general public. Stamps were printed and sold to the various merchants at 25 cents each.

The Parking Stamp Plan

Shoppers were given a parking ticket on entering a lot with the time stamped on the back. Any cooperating merchant affixed a stamp on the shopper's parking ticket, thereby entitling the shopper to two

hours' free parking. No purchase was required, and most merchants were pleased to have any and all parkers enter their store to receive the stamp. The good will and success of bringing the shopper into the merchant's store was well worth the quarter spent.

The Authority was thus spared bookkeeping or accounting costs as only cash (for non-stamped tickets or overtime) and stamps were received at the lots. The stamp fund was escrowed and transfers were made to the general fund only against stamps used, all handled by the bank depository in their daily receipts. This program was modified after a few years and a three-stub parking receipt is now used. Each stub is good for a ten-cent credit. A merchant today honors one or more of these stubs (which are dated by the car attendants) with a credit on purchases made in his store. Thus, today with minimum parking fees of 25 cents for two hours, a shopper can still park absolutely free and even have a five-cent profit.

The facilities of the Parking Authority consist of three lots, as shown in the map. Car spaces now total 438. Actual use runs about 4200 cars a week of daily parkers and estimated 5025 weekly, including the monthly and weekly parkers. Rates vary slightly and are as follows:

	No. 1 Lot	No. 2 Lot	No. 3 Lot
First two hours (Monday to Thursday) . . .	$ .25	$ .25	$ .15
First two hours (Friday Night & Saturday) . .	.35	.35	.25 (1 hour)
Each additional hour	.10	.10	.10
Maximum Daily	.50	.50	.35
Weekly Rate	1.75	1.75	1.25
Monthly Rate	7.00	7.00	5.00

Despite all efforts to bring more shoppers into the lots in the first four weekdays, experience still shows that 60 percent of the parkers use the number 1 and number 2 lots on Friday (shopping night) and Saturday. This results in all-full signs appearing frequently on these latter days. Pre-holiday periods, such as Easter, Thanksgiving and Christmas, of course, prove heavy and a record 8499 cars were parked in the week ended December 19, 1954. Much is being done to level off this pattern for the benefit of the shopper, the merchant, and

the Authority. Sales-days and campaigns are numerous, all aimed at Monday to Thursday use of the car parks.

Each car park has a single vehicle entrance with an attendant's booth. All cars are parked by the drivers in well-marked stalls and may be locked. No meters are used. All fees are paid upon leaving the car parks in accordance with elapsed time as recorded by a calculagraph installed at each booth. An additional pedestrian entrance is provided on each lot to facilitate the parker in entering or leaving the lot on foot.

Luminous Directional Signs

The Authority is embarking on a broad program to place additional luminous directional signs in arrow shape in almost every part of the city emphasizing the main arteries of approach from the surrounding communities. A program has been developed with the help of the Passaic Valley Citizens Planning Association indicating the most urgently needed locations and sizes of signs. By wise budgeting, a major part of this program will be accomplished this year and the balance in 1956.

Recognition of the economic aid to Passaic by the Parking Authority led to the creation in 1954 of a Citizens Committee by the mayor. This group has met diligently and has explored all problems of traffic and parking, realizing that the two problems are closely related. With the further realization that on-street meters and location or relocation are pertinent, they are attemping to develop an overall program for a unified control. Such a program would materially aid the Authority to develop new off-street facilities or enlarge present locations. It is expected that this fall a program of expansion will begin to take form.

The Traffic Engineering in Ontario

W. Q. MACNEE

Mr. Macnee has been Traffic Engineer in charge of the Traffic Engineering Section of the Ontario Department of Highways in Canada since October, 1953. He is headquartered at Ottawa. Mr. Macnee is secretary-treasurer of the Canadian Section of the Institute of Traffic Engineers, a member of the Association of Professional Engineers of Ontario, a member of the Ontario Joint Highway Research Project, and of the technical committee of the Ontario Traffic Conference.

AS A PROFESSION, traffic engineering in Ontario first saw the light of day in the Planning Department of Toronto in the middle 'thirties. It wasn't until after World War II, however, that a Traffic Department was formally established.

After the war, the Ontario Department of Highways began to think of traffic engineering as a separate function. In 1946, a volume census group was formed—the nucleus around which the Traffic Engineering Section grew.

At approximately the same time, several of the larger cities became interested in traffic engineering. A scarcity of qualified men led to the establishment of traffic co-ordinating offices where traffic engineering studies and functions were performed without the formal guidance of a traffic engineer.

When, in 1952, the Municipality of Metropolitan Toronto was created, consisting of Toronto and its twelve suburban municipalities, a traffic engineering department was created. This department supplies the traffic engineering for major trunk roads in the area excepting those in Toronto proper and highways under the jurisdiction of the Ontario Department of Highways.

Pattern of Growth

The growth of the Traffic Engineering Section of the Ontario Department of Highways has followed much the same pattern as used in the United States. If any difference, it probably is in the rate of growth. In 1946, a staff of three men took volume counts in the

Province. To-day, after nine years, the section has grown to the point where the staff of seven engineers and twenty-five others can hardly cope with the work. In addition to this full-time staff, thirty engineering under-graduates are hired each summer to handle special field studies.

Department of Highways—Ontario

As a result of recent internal reorganization, the Ontario Department of Highways now has the basic organization shown in Figure 1. To a large extent, this organization is self-explanatory. The director of planning and design is responsible for all pre-engineering including both roadway and bridge design. When the project is ready for construction, it becomes the responsibility of the chief engineers branch to call tenders and see the job through to completion. The maintenance of the highway system also comes under the chief engineers branch.

The services manager is responsible for property acquisition, building permits and generally accepted services—vehicles, office supplies, etc. The registrar of motor vehicles, although part of the general organization, is responsible directly to the minister.

In Ontario, the department of highways has full jurisdiction over the King's Highway System and the secondary roads system, often referred to as the provincial highways. The department has no control over any urban streets but does have *connecting link* agreements with municipalities where the provincial financial grants are usually higher than the normal 33⅓ percent.

The King's Highway System consists of primary highways in the province, or highways that carry inter-county travel. There is only one federal route in Canada, the Trans-Canada Highway. For this highway, the federal government has established minimum design standards and contributes 50 percent of the total cost. Upon completion, this route will come under the jurisdiction of the various provincial governments for all purposes. The federal grant is for construction only, at least under the current legislation.

The secondary road system, primarily in Northern Ontario, consists of development roads with the purpose of opening new areas. They are also prevalent throughout the vast recreational area.

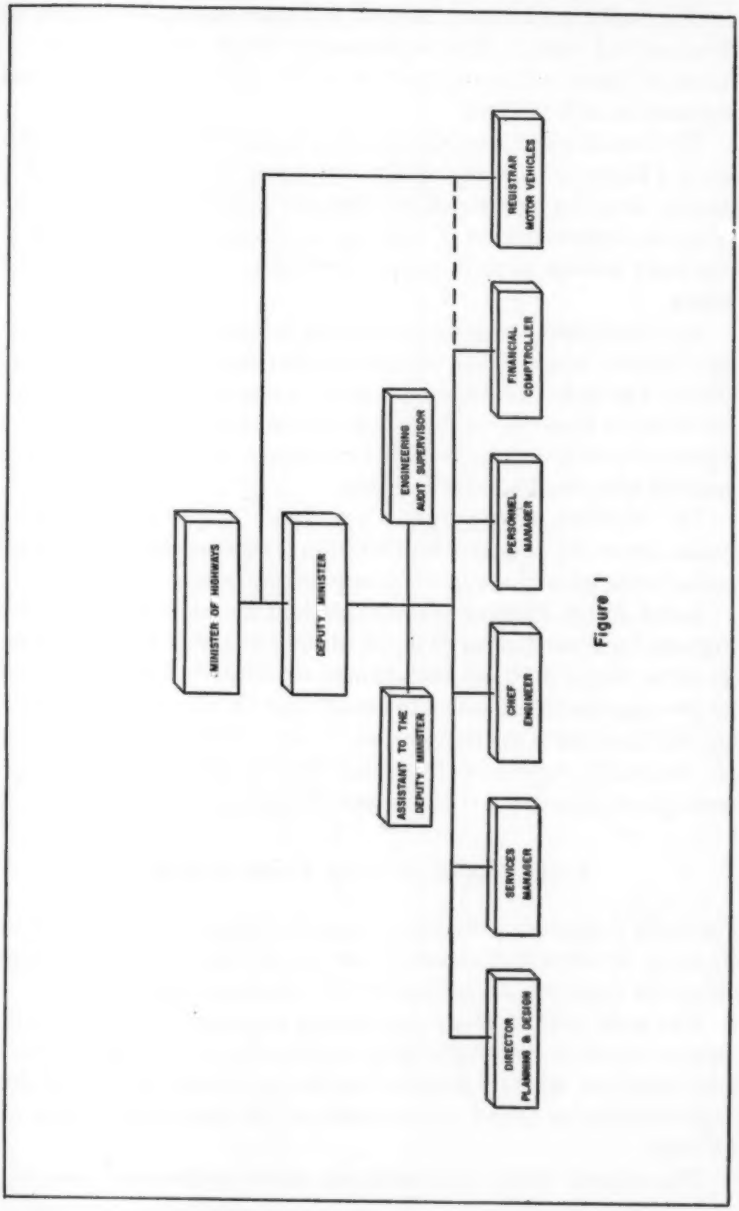

MINISTER OF HIGHWAYS
DEPUTY MINISTER
ASSISTANT TO THE DEPUTY MINISTER
ENGINEERING AUDIT SUPERVISOR
DIRECTOR PLANNING & DESIGN
SERVICES MANAGER
CHIEF ENGINEER
PERSONNEL MANAGER
FINANCIAL COMPTROLLER
REGISTRAR MOTOR VEHICLES

Figure 1

The traffic engineering section is a part of the directorate of planning and design. The organization within this directorate is shown in Figure 2. Functions of the traffic engineering section will be described in detail later.

The statistics and economics section is responsible for compiling detailed highway information and arranging this information in a suitable form for programming highway improvements. This involves the determination of highway needs and the preparation of sufficiency ratings as well as the correlation of other ratings and factors.

The road plans and priorities section is responsible for establishing a priority program for all construction on the King's Highway System. The priorities engineer will base this program on information received from the statistics and economics section and the traffic engineering section along with the knowledge of local conditions as obtained from the division engineers.

The location section locates new routes, and revises existing routes, where the primary consideration is topography. Within this section is the photogrammetric group among others.

In the design division, the final plans of the proposed routes are prepared for construction. The scheduling engineer is also a member of the design division. His primary function is to co-ordinate all the pre-engineering in order to ensure that all plans, specifications etc., will be ready at the time the tenders are called for any particular job. He is also responsible for seeing that the program of pre-engineering is in accordance with the priority program.

Traffic Engineering and Traffic Studies

The traffic engineering section is organized along the lines shown in Figure 3. As the organizational chart shows there are four groups within the traffic section each of which is further subdivided.

The traffic studies group is primarily responsible for field work required by the traffic engineering section. For administration purposes, there are separate units to handle the volume census and the origin-destination survey work because of the continuing nature of the work.

The volume census unit maintains eleven permanent counting

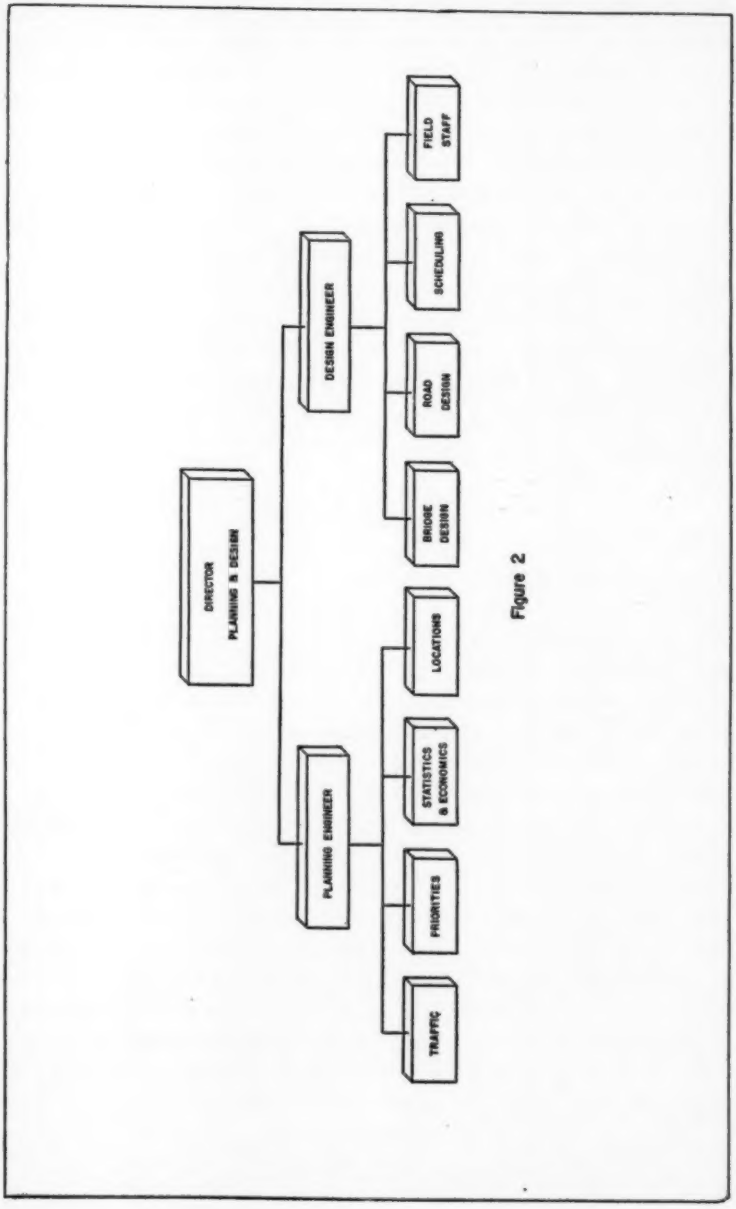

DIRECTOR
PLANNING & DESIGN
PLANNING ENGINEER
TRAFFIC
PRIORITIES
STATISTICS & ECONOMICS
LOCATIONS
DESIGN ENGINEER
BRIDGE DESIGN
ROAD DESIGN
SCHEDULING
FIELD STAFF

Figure 2

stations, one hundred semi-permanent stations (5 days per month), two hundred stations (forty-eight hours every two months), and about two thousand short count stations (twenty-four hours a year). It is intended to increase the number of permanent count stations to a total of approximately fifty in the next few years.

The origin-destination unit handles all the field studies in connection with origin-destination work. The personnel is almost entirely made up of summer employees—usually university undergraduates. The studies are of the external, roadside interview type. To date, since 1950, approximately forty-four urban areas have been studied and interviews made on some 180 roads. In excess of 500,000 interviews have been made and tabulated.

The special studies unit handles all other survey work as required. This includes intersectional traffic studies, speed studies, speed and delay studies, etc.

Traffic Analysis Group

In essence, this group develops the field data so that it can be used in the planning and design aspects of the department's work.

The traffic characteristics unit develops from the data received from the volume census unit the annual average daily traffic volumes, design hourly volumes, and hourly, daily and seasonal variations. They also develop such items as speed trends, driver behaviour characteristics and such other items as would logically be included under the term *characteristics*.

The route analysis unit is the primary planning unit within the traffic enginering section. Armed with the data supplied by the characteristics unit and the studies group, they develop reports and recommendations about new routes and revisions to existing routes. They develop potential volumes, design criteria, and recommendations up to the geometric design, where the location section takes over.

This group recommends approval or disapproval, based on traffic considerations, of shopping centres, supermarkets, and other congestion-producing developments. This, of course is limited to such developments as would affect the King's Highway System. Proposed by-passes are also studied.

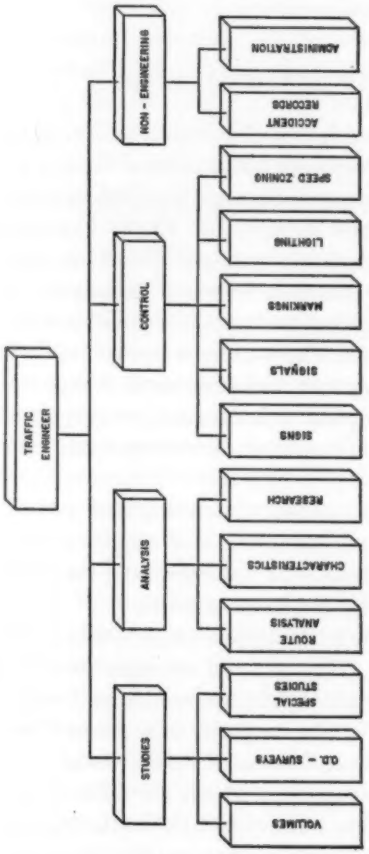

TRAFFIC ENGINEER
STUDIES
VOLUMES
O.D. - SURVEYS
SPECIAL STUDIES
ANALYSIS
ROUTE ANALYSIS
CHARACTERISTICS
RESEARCH
CONTROL
SIGNS
SIGNALS
MARKINGS
LIGHTING
SPEED ZONING
NON - ENGINEERING
ACCIDENT RECORDS
ADMINISTRATION

Figure 3

The research unit handles special studies of a research nature that arise. This unit will work in close co-operation with the newly formed joint highway research project. This project, patterned to a large extent after the Purdue Joint Highway Research Project, is a co-operative effort between the Ontario Department of Highways and the two engineering universities of Ontario—the University of Toronto and Queen's University.

Traffic Control Group

Basically this group provides a staff function with respect to all traffic control devices. All requests for traffic control devices are forwarded to it for processing. These requests are handled in one of two ways. In one case, the "Request Manual for Traffic Control Devices" is forwarded to the requesting municipalities. This manual, copied freely from the "Idaho Request Manual," shows the municipality what traffic data are required and supplies the necessary field forms. The request manual, when the data have been compiled, is returned to the traffic control engineer and processed. A recommendation is made concerning the request. It is necessary to spot-check the data at frequent intervals to ensure that no enterprising municipality is "cooking" the results.

The other method consists of sending our own investigators to the location. This is impractical in many instances, because of enormous distances in Ontario. From this point, the method becomes the same as in the case of the request manual.

The control group is in the process of preparing uniform manuals for control devices. The manual on signs is currently at the printers and the pavement marking manual is well under way. Many changes are scheduled for the majority of signs in Ontario. We are gradually converting to the Bureau of Public Roads Manual. There are, however, a few instances in which we differ from the B.P.R. Manual. The major point of difference lies in the handling of school crossings. In this regard, we are, apparently, consistent with most states, in that we are inconsistent with the manual.

Speed zoning creates a minor problem to the traffic engineering section, as we operate on the two-zone system. In rural areas that are not built up the speed limit is 50 mph, whereas in urban areas and

rural areas where abutting property is built up the speed limit is 30 mph. The only exceptions to this rule are, (1) in the case of level crossings where the limit is 20 mph and (2) in parks and cemeteries where the speed limit is 15 mph.

Recently the Ontario legislature passed a law permitting incorporated municipalities to speed-zone their streets according to needs. These speed zones can range from a low of 25 mph up to a high of 50 mph. Indications are that a similar variable speed zoning law will soon be enacted to cover rural roads. If this legislation is passed, it is the Traffic Control Group who will probably handle this problem.

Accident Records and Administration Group

This group is responsible for the non-engineering functions of the traffic section. The most important function is the maintenance of a location file for all accidents occurring on the King's Highway System. The motor vehicles branch maintains a statistical record of all reported accidents in the province; however, these records do not include adequate information with respect to the locations where these accidents occur. To compensate for this, the investigating police are required to submit an additional copy of each report so that the traffic engineering section can develop an accurate location file. Although this does result in duplication of records, it was felt that it would be less costly in the long run than if the motor vehicle branch had been required to alter the entire system of recording accidents.

This location file is used to develop accident rates and to point out accident prone locations.

In addition to the accident records, this group is responsible for the administration of the section and looks after such items as typing, draughting and personnel problems, etc.

This, then, is an outline of the functions of the traffic engineering section in the Ontario Department of Highways. But what sort of traffic conditions does the section have to deal with? Before answering this question, it would, perhaps, be wise to see what Ontario is like.

There are two major sections in Ontario, appropriately called Southern and Northern Ontario. Southern Ontario is a relatively

small area with a rather dense population, whereas Northern Ontario is a large area with a very sparse population.

Southern Ontario

The area of Southern Ontario accounts for only some 10 percent of the total area of Ontario. However, in that area live the largest proportion of the people. Nearly 90 percent of the population is in Southern Ontario (4,140,000 in 1953). In the same area over 90 percent of the vehicles are registered.

The department of highway maintains more than 4,700 miles of King's Highway in Southern Ontario. On the basis of 1954 traffic volumes, the average A.A.D.T. on this network of roads was 2,560 vehicles a day. This network of highways is strictly rural as the department does not have direct jurisdiction over any urban roadways (except insofar as the province contributes financial aid towards their construction and maintenance).

The individual A.A.D.T.'s (average annual daily traffic), have a somewhat normal range in values from upwards of 40,000 vehicles a day on the Queen Elizabeth Way, down to as little as eighty vehicles a day on some farm-to-market routes. The most heavily travelled routes are in the vicinity of metropolitan Toronto, where we estimate that the nine King's Highways entering this area carried approximately 110,000 vehicles a day during 1954.

In the areas where summer tourist travel predominates we find somewhat fantastic seasonal variations in volumes. For instance, one of our permanent counters show that the August A.D.T. is some 6.6 times greater than the January A.D.T. This, of course, is a primary tourist route. The overall average for the Southern portion of Ontario shows that the August A.D.T. is 2.6 times the January A.D.T.

Northern Ontario

Northern Ontario is a large area, occupying some 90 percent of the total area of the province. Its 325,000 square miles make it bigger than Texas. Despite the size there are only 509,000 persons living in the area. The vehicle registration is naturally correspondingly small.

The department of highways maintains some 3,350 miles of King's Highways in Northern Ontario. This mileage carries an A.A.D.T. of 700 vehicles per day. The department also maintains a considerable mileage of secondary roads in Northern Ontario.

Oddly enough, the traffic volumes on many of these roads are heavier in winter than in summer. This apparently is because there is a better road surface during the winter when the sub-grade is frozen than in summer.

Between Southern and Northern Ontario lies one of the major tourist regions of Ontario. It is sparsely populated during the winter months but becomes almost densely populated during the summer months. It is in this region that the tremendous seasonal variations in traffic volumes occur. This is also the region that generates the majority of the tourist traffic. To complicate matters, all the traffic between Southern and Northern Ontario—and it is considerable—is funneled through this area on one major artery. As a result, this highway carries approximately 3,000 cars per day during ten months, but during the other two months (July and August) the volume jumps to about 9,000.

An interesting problem arises here. Is it economically justifiable to construct a highway that will handle this summer traffic, when the highway will be enormously over-designed for ten months of the year, and when there are other highways in the Province that are only slightly over-capacity, but are over capacity for the full twelve months? The 30th highest hour on this particular road is approximately 29 percent of the A.A.D.T. In fact the 30th highest hour exceeds the twenty-four hour volumes of many of the off-season days.

Traffic Characteristics

Vehicle registration in Ontario is such that there is one vehicle for every 3.3 persons in Ontario. This figure has been dropping rapidly since the end of World War II and the era of the two-car-family approaches for the Province.

Hourly variations and daily variations are almost identical to the normal variations found in the U.S. In fact almost all characteristics are the same as found in the U.S. One point where the characteristics tend to vary somewhat is in the case of speeds. Rural speeds in

Ontario tend to be somewhat lower on the average than in American rural areas, but on the other hand, urban speeds tend to be somewhat higher.

The reason for this variance seems to be in the legislation affecting legal limits. All rural roads have a top speed limit of 50 mph. Even the dual lane access-controlled highways have this same limitation. As a result the speeds are somewhat lower than those in the States where "reasonable and prudent" rules are in effect. In urban areas the speed limit has been a flat 30 mph. for many years and the average motorist seems to drive up to the limit all the time. It is a bit disconcerting to many visitors to the Province to get caught in this relatively fast flow of traffic on the busier urban streets. It also has the unpleasant effect of making the Ontario motorist drive like a speed demon when visiting neighbouring U.S. cities where the limit is usually 25 mph.

Tourist Traffic

Ontario's vehicle registration of 1,487,210 (1954) is augmented each year by a rather substantial influx of American vehicles: for instance, over 5,700,000 American vehicles entered Ontario during 1954. The border crossings naturally reach a peak during the summer months, and in July 1954 approximately 1,050,000 vehicles with U.S. registry entered Ontario to stay for varying periods of time.

With tourist traffic of this magnitude, one can easily understand why we have such terrific seasonal variation in traffic volumes.

Origin-Destination Surveys

As the department of highways has no jurisdictional control over urban areas the origin-destination surveys in the past have all been strictly external in nature. As mentioned previously some forty-four urban areas have had external surveys made.

During this summer (1955), additional surveys are being made at seventeen municipalities. In addition a start will be made on the external portion of the comprehensive study of Metropolitan Toronto. The Metropolitan Planning Board is currently conducting an Internal O-D Study and the external survey that we are to perform is to complement this study.

One feature of the type of survey that we have been performing is that it provides a wonderful opportunity to check required sample size and accuracy of the results. Because of the large numbers of locations surveyed, we find that many major trips have been picked up at as many as twelve different locations and at just as many different times of the year. One of the projects that has been suggested for study by the joint highway research project is the investigation of this information.

One interesting fact that has come out of these studies is the fantastic length of trips some motorists take on so-called holiday weekends. An example of this is the following authenticated trip. The vehicle left Toledo, Ohio, on a Friday at 2:30 p.m. and drove via Detroit and Toronto to North Bay. (Distance—520 miles).

On Saturday the drivers proceeded by way of Ottawa and Montreal to Burlington, Vermont. (Distance—472 miles). Then on Sunday they returned to Toledo via the Adirondacks, Buffalo and Cleveland. (Distance—688 miles). Thus in two and a half days they had covered some 1680 miles and they had the nerve to tell the O-D interviewer that the purpose of the trip was pleasure driving.

Signing

The department has just completed a new uniform sign manual. This manual follows the B.P.R. Manual to a large extent. At the present time experimentation with respect to the Red Stop sign and the Yield Sign are under way. There is a reluctance to convert to the Red Stop Sign as long as the Yield Sign is not available for use. This is due to the current over-usage of Stop Signs. Experimentation into the use of the three color code for Signing is also under way. In this system, Red is for Stop, Yellow or Amber is for Warning, and Green is for the GO Signs, i.e., direction Signs. Regulatory signs will continue to be Black on White. This colour combination, used on provincial police cruisers, seems to best represent the law.

School Crossings

The traffic engineering section has recently recommended a new policy with respect to signing in school areas. This proposal has re-

Advance Warning Sign

Identification Sign

Figure 4.

ceived approval and should be in operation at the start of the school year in the fall of 1955.

The main points in this program are as follows:

1. Signs are to be removed when school is not in session.

2. Where the school yard is operated as a playground during the summer months a different and distinctive sign will be used.

3. As the "School Ahead" warning is not really the warning of a hazard to the motorist a shape different from the normal diamond warning shape is to be used. The shape decided on is the general shape of the little red school house.

4. The first consideration was to use Red in line with "The Little Red School House" idea; however, this was discarded as Red should be reserved for "Stop." Amber was out for the same reason as the diamond shape was out. We finally settled for a blue background with white letters (see Figure 4).

5. At points of crossing, the department will erect the Walking Children Sign (Figure 4) and paint cross-walks, only if the local school board assures the department that supervision will be provided. We rejected the "Running Boy" Sign as it was in direct opposition to the safety rule of Walk, Do Not Run.

The Ontario Department of Highways in co-operation with a United States signal manufacturer started the use of the oversized lens in traffic signals. In recent months various organizations have requested "before and after" data with respect to these lenses. Unfortunately no such data are available because the changeover to these oversized lenses had been completed before the proper engineering accident records were started. In fact all red lenses have been twelve inches since 1941 on the King's Highway system, while the location file on accidents was not started until 1948. Several of the municipalities have also adopted this oversized lens.

From our own observations the biggest advantage of the oversized Red is that it stands out sharply in contrast with the normal sized Green and Amber and there would appear to be little advantage in making these lenses twelve inches.

Accidents

When it comes to accidents, Ontario is neither better nor worse than any other place on the continent. The average accident rate on the King's Highway System is 3.1 accidents per million vehicle miles in Southern Ontario and somewhat higher in Northern Ontario—perhaps on account of the longer winter season with its resultant slippery roads. Apparently there are just as many of the "reckless few" in Ontario, as there are anywhere. The fatality rate of 8.3 for the province is steadily decreasing.

To help combat the rising accident toll, the National Highway Safety Conference was recently inaugurated. This conference is modelled along the lines of the President's Conference in the United States and the spade work done in the United States has enabled us to get our organization off to a flying start.

Ontario Needs Traffic Engineers

This then is an outline of traffic in Ontario and of the organization that the department of highways has developed to handle the traffic problems. We realize that the organizational set-up is far from perfect and we are willing to revise it whenever it has been clearly shown that a revision would enhance our operation. The biggest

problem is the need for extension of the traffic engineering profession, not so much within the department, as within the larger municipalities. There exists a real scarcity of qualified traffic engineers in Canada, to which the following statistics give witness:

1 Traffic engineer for every 26,000 miles of highway.

1 Traffic engineer for every 189,000 registered vehicles.

1 Traffic engineer for every 750,000 persons.

These ratios must be reduced before any material gains can be made against the growing highway traffic problem in Ontario.

Fortified Traffic Control

CARL F. HANSSON

Chief Carl F. Hansson has been a member of the Dallas Police Department for twenty-one years, serving in the grades of sergeant, detective lieutenant, and inspector. He was appointed chief in May, 1945. Chief Hansson is immediate past president of the International Association of Chiefs of Police and a past president of the Texas Police Association. For the last five years the International Association of Chiefs of Police has awarded Dallas first place in police traffic supervision for cities in its population bracket.

LAW enforcement officers are so young they missed the hardships from 1929's financial collapse. More mature, experienced personnel remember when the economic props literally fell from under the financial structure of the world.

That collapse brought austere living, unemployment, and other difficulties to which the generation was unaccustomed. It made less attractive the American concept of free enterprise and competition and more desirable any enterprise that offered security however less remunerative the enterprise might be.

People not only accepted but demanded governmental controls to assure employment and above all, security. The federal government began to create bureaus to take over various aspects of our economic structure to give employment, stabilize the economy, alleviate widespread fears and bring about that all-important "security."

A Faith in Symbols

The bureaus brought an era of symbols: the WPA, PWA, TVA, FHA, NRA, and a host of others. The average citizen knew little of their inner workings beyond their offering to him something of economic value. So these symbols somehow spelled economic security to the average man on the street.

This symbolism created a sense of grasping at some Utopia. Most of us accepted any combination of the alphabet as something constructive—as something good for us.

The tantalizing offer of nebulous advantage carried into present-

day selling. From tooth pastes to motor oil, alphabetical additives claim "fortifying" qualities sometimes unrelated to the principal use of the product.

In the last few years, the public has confronted so many new developments that we accept the end result without attempting to understand the means by which they were accomplished. Most of us are not trained to understand nuclear energy, electronics, chemistry, medicine, or other highly specialized fields. We developed a faith in discoveries and invention that often leads to our accepting most anything from a reputable firm presented as having a new and mysterious quality for good.

This concept of symbolism is suggested as an important ingredient in modern traffic control. To be effective, any program of traffic control and accident prevention must have EDS added. This additive, nebulous and intangible as some of the ingredients of modern merchandise, is very real. It can be seen and felt in every successful traffic program.

For a better view of EDS let us develop the traffic problem in several of its aspects:

Quantity of Crime Vs. Quantity of Accidents

What is the relative importance of the motor vehicle accident problem to the police and the public compared with the crime problem? First, the relative size of the two problems: Crime figures from the Uniform Crime Report of the Federal Bureau of Investigation, and motor vehicle accident figures from Accident Facts, published by the National Safety Council, show the *quantity* of the accident problem much larger than the quantity at least of crime.

Murders	Motor Vehicle Fatalities
National totals 1953	
7120	38,300
Aggravated Assaults 92,600	Motor Vehicle Injuries Disabled beyond day of accident 1,350,000

(Property loss crimes)	Property damage motor vehicle
thefts—robbery	accidents
burglary (auto theft)	3,550,000
2,035,770	
Total of all	Total of all
criminal offenses	motor vehicle accidents
2,159,080	9,900,000

Traffic Accidents Not Secondary

I would not attempt to place either of these problems in relative overall importance because sociological factors enter into such valuations. We confront undesirable choices in both problems. Yet it can be logically conceded that the traffic problem is not a secondary consideration in law enforcement.

Traffic congestion is a traffic factor not so easily measured as accidents. We cannot say how much time and gasoline are wasted, or how much wear and depreciation occurs needlessly as a result of congestion. But from the number of vehicles registered, it is undoubtedly tremendous.

Solving this problem is immensely important to the economic and social well-being of our country. And it is being worked on by many agencies on a national, state, and local level. Agencies fortified with EDS show a stimulating record of reducing both congestion and accidents. They are rendering a valuable service to their communities.

Fundamental approaches to the problem are through the well-known avenues of education, engineering, and enforcement. The degree to which these fundamentals are effective depends upon the soundness and logic of the methods used, the ingenuity with which devices are applied and the acceptability of procedures to the public.

Objectives

The objective of traffic engineering is to provide the best functional use of existing roadways with a reasonable balance between safety and movement. Also to plan routes and functional design for new streets and highways.

The objective of the traffic safety educator is to bring about voluntary compliance with regulations applied to the use of streets and highways through educational and advertising techniques for masses, specific groups, and individuals.

The objective of the police is to aid in the function of the streets and highways by manual assistance at intersections and through parking control—and to gain widespread *voluntary* compliance through *enforcement* of regulations, for safe operation of motor vehicle transportation.

A fourth element is the courts and prosecutors. Our courts to a large degree regulate the effectiveness of our enforcement program. However intelligently and diligently enforcement is applied, a judge or prosecutor not sincerely interested in the traffic problem can defeat the best enforcement effort devised.

Coordinated and Fortified

None of these areas of control can have a maximum effect without the aid of the others. All must co-ordinate their efforts in harmony toward a common goal. All must be fortified with EDS.

First of all, the police should examine the need for traffic officers in moving vehicles smoothly and in parking control. Where, when, and how much? That should dictate the number of officers necessary to give adequate assistance to traffic. Nothing brings public criticism more quickly nor more vehemently than inadequate and inefficient police-handling of traffic. Conversely, nothing is appreciated more, or brings quicker enthusiastic commendation to an officer and his department, than an efficient, well-trained, traffic officer of material assistance in stimulating a rapid flow of traffic through an intersection.

The same attitude of the public exists as to parking control. Parking limitations and restrictions are accepted in good grace if enforced rigidly, impartially, and fairly. Better have no parking restrictions than to have them without requiring people to obey them. It is ridiculous to have two-hour limits and let cars park all day; or to have "tow-in zones" and never tow a car in, or to have no-parking zones and let cars occupy them. Lax enforcement destroys the respect for police and undermines the rest of a traffic program.

There is a place for specialized traffic officers. But like lax parking enforcement, it breaks down public confidence to see police in cars and on beats who do not enforce traffic regulations because they are not connected with the traffic division.

Every Police Officer a Traffic Officer

To get enough enforcement to bring about a reasonable degree of voluntary compliance, every uniformed officer on duty should be required to enforce traffic laws.

An effective program of traffic control and traffic safety for large departments requires that there be specialized units for point control, parking enforcement, accident investigation, special enforcement units—motorcycle, radar, motor vehicle inspection if it applies, driver-license enforcement, follow-up units for hit-and-run accidents —school patrol and safety education.

All of these needs exist also for the small department but in a lesser quantity. Thus a few officers in small departments should be trained in the techniques of investigation, enforcement, and control. Thus they may be used to their full advantage.

Police Must Be Trained

No department can be adequately effective without properly trained men. The greatest economic waste that any city experiences is hiring inexperienced men, expecting them to learn to be policemen through contact with other policemen and the public. They may eventually become officers but only after much inefficiency. Often they end up with disastrous results, to themselves and to the public.

Formal classroom training will not make an officer without experience, but neither will experience without training produce a top-flight policeman. We don't hire clerks for plumbers, typists for nurses, or truck drivers for commercial artists; yet that is too often the procedure in hiring officers. Because experienced police officers are usually not available for hiring, it is necessary to train the rookies we hire, if we expect to get the best from them.

Enforcement is at best a deterrent, not a compeller. There can never be enough enforcement to compel society to obey. In its

broadest concept, enforcement is educational. In only a minority of cases is it intended as punishment. It is intended to convert the driver to better driving and furnish an example to others. Enforcement is not necessarily arresting the driver. It may merely be the presence of an officer for psychological effect, an admonition, or a written warning.

Driver-license examinations, interviews, motor vehicle inspection, and publicity on enforcement are a type of enforcement applied to the masses. Individual officers undoubtedly often ask themselves: "Is enforcement necessary against drivers from the substantial element of our society?" Unfortunately, it is necessary because a minority really are anti-social, and because of drivers who know better but still seek thrills. It furnishes a stop-gap for the deficiencies in adult and child-safety education.

Factors governing the effect of our enforcement are the reasonableness of the law and demands for its obedience, the percentage of violations occurring detected, and the percentage of violations detected in which some action is taken. This in turn influences the individual citizen's opinion of his likelihood of being caught. The last measure of effectiveness is certainty and adequacy of the penalty.

Every enforcement officer should be aware of these purposes, objectives and reasons for enforcement to build within himself a desire to carry out his duty to society. Such awareness is an ingredient of EDS.

All of the relationships of the police to the management of the motor vehicle transportation system are either types of enforcement or devices for a logical direction of enforcement techniques.

Investigation Discusses Guess-Work

Accident reports resulting from police accident investigation could be put to valuable use by many individuals and groups such as attorneys for litigants, insurance companies, advertisers, and many industries, but these uses are not the purposes of accident investigation for the law enforcement officer. Even prosecution resulting from the investigation is of secondary concern. The principal purpose of investigating accidents is to provide quantities of valid factual data upon which to base a logical and effective enforcement program.

That program is one of selective enforcement aimed at cause, time, place, and group. For the educator such statistics direct his efforts in the same way in the proper direction. For the traffic engineer such data furnish the nucleus for safety engineering on existing roadways. They help him resist demands for engineering in places it is not needed. Such data take the guess-work out of planning for all phases of traffic safety and control.

An understanding of these purposes should be clear to every investigating officer because, for the data to be valid, the investigation should be pursued with diligence to arrive at the true facts. Some of the data called for on accident reports can be conclusions but should never be guess-work. Accident-investigation, therefore, should be carried out by well trained personnel imbued with that elusive ingredient, EDS.

Reasonableness of Law and Police

However well planned an enforcement program may be, it must be acceptable to a majority of the community. It is wise to remember that ours is a government of the people—God forbid never of the police, by the police, and for the police. This is not to say that the public will not accept enforcement of the law; for they will. Yet the degree of acceptance is based on the reasonableness of the law and the reasonableness of the police.

Even a well planned enforcement program, properly advertised and supported, can fail to obtain widespread voluntary compliance, if enforcement is seen to be inconsistent. Inconsistencies can only be avoided by clearly defined policies of a police administrator. When we ask ourselves what degree of tolerance should be given in various types of violations, we can summon to mind many degrees of tolerance and support each with a valid reason. Yet however valid the reason for tolerance, the degrees of it differ among individuals.

Should a tolerance on speed be one mile over the limit, or five miles, or ten miles—or should *no* tolerance be shown? If this decision is left to the individual officer, a wide variation in enforcement can frustrate the motorist. When a driver five miles over the speed limit finds his excess "tolerated" in one section of a city or state, and receives a traffic summons for the same degree of violation in another

section, he feels he has been unjustly arrested. He cannot know what is expected of him.

Another deficiency in our enforcement effort arises when a driver's attitude is permitted to influence the degree of enforcement. Here are two hypothetical cases:

Differences in Enforcement

A taxi driver receives a call to the outer edge of the city to pick up a passenger. Upon his arrival, the prospective passenger has found other means of transportation. The driver made his run for nothing —what is commonly called a "water haul." Suppose this is his third water haul today. It cut into his revenue, and eager to recoup his loss, he exceeds the speed limit by five miles an hour.

An officer pulls him to the curb, probably to caution him to hold his speed down. But the irritated driver snaps at the officer: "Go ahead, give me a ticket. I know you gotta make your quota. Why don't you guys pick on some of these rich birds and let us cabbies alone?" He gets a ticket, not because of his violation but because his attitude annoyed the officer. Is our objective of voluntary compliance furthered?

An opposite case is that of a salesman. He makes his living by *persuading* people. He is trained to be tactful and his extrovert personality is pleasing. He is in a hurry too, and sails down the street at ten miles an hour over the speed limit. An officer stops him to issue a ticket, but the salesman turns on the charm.

He knows how to place himself at the mercy of the officer and how to persuade the officer that his mission is urgent. So, he is released with a warning—not a written warning, mind you—the verbal warning no one can check. It was the salesman's third warning this month. Again, attitude, not the violation, influenced the degree of enforcement.

Such differences in enforcement seem like special privilege, totally unacceptable to the American public, lending credence to the question often directed to the police, "Why don't you give the rich driver a ticket?"

It isn't that we make a distinction because of economic station in life or even social station, but diplomacy and tact are a natural part

of the personality of most successful people and is a planned part of their attitude. Thus we should strive to avoid basing decisions on attitude.

Understandably, such influences are hard to keep out of our decisions. It can only be done by complete comprehension of the fundamentals of traffic-law enforcement, and sincere effort by the individual officer to be entirely without prejudice and unbiased in applying his department's enforcement policy.

Control: Point and Intersectional

Leaving the area of enforcement we come to its first cousin, *traffic control*. Control involves the manual assistance of the police at intersections and the enforcement of parking regulations closely associated with the movement of vehicles. The concept of traffic control should be helpfulness and stimulation to movement rather than something restrictive.

Our interest in this phase of traffic is directed toward getting the most efficient use of our streets. To do this we should consider the problems of parking, on-street and off-street, mass transportation movement and the best use of streets with insufficient capacity.

Most cities have streets poorly arranged for today's heavy traffic. Many small towns with public squares are traffic monstrosities. And some large cities have intersections where three or more streets come together, or where two streets merge instead of bisecting. Our southern cities are noted for their narrow streets and unequal lengths of blocks.

Such conditions make it virtually impossible to equalize the flow of traffic with signal systems. Engineers do an outstanding job with what they have to work with, but many situations cannot be fully solved without costly changes in both streets and intersections.

Careful Training

The more prevalent these conditions in a city, the greater the need for police assistance. When police ignore the conditions a cry from the public for assistance invariably results. Gratifyingly, police and engineers ingeniously use traffic cones, portable signs and sig-

nals, public address systems on police vehicles, and even radio direction to get the best movement on thoroughfares during peak hours. Such ingenuity and efficiency can only come from those steeped in EDS.

Proper manual control of intersections requires training. Uniformity of hand signals and clear, understandable signals come through training and understanding the driver's visual problems. Training affords an understanding of the need for equalizing the flow from different directions and the coordination of flow between a series of signals. It teaches the principles involved in assistance to turning movements. Many of our colleges and universities are offering such training through extension services. Wise police administrators make such short courses available to their men.

Traffic Education

Another important police function in a traffic control and traffic safety program lies in the field of education. In some large cities, departments of Traffic Safety Education have been created in the city government. In all such cases the police take an important role of safety education in liaison with such departments. If no such special department exists, the police should not miss the opportunity to carry on such a program from their own department.

The citizenship will accept a program of traffic enforcement which to them seems logical and fair, and one in which they can see a benefit in the prospect of reduced accidents. Fine opportunity exists for obtaining *voluntary compliance* through education and in *selling the police product* to the public.

For the promotion of educational programs men should be carefully selected. Officers who take part in these programs should be thoroughly acquainted with the traffic problem and the objectives of the enforcement program. They should possess good personality: be pleasant, firm, conduct themselves with dignity, and carry themselves well. They should be sincerely dedicated to their job. Their *sincerity* and *dedication* should be apparent in their *enthusiasm* to put over the program.

Even small departments should have one or two men trained and prepared to appear before groups. Civic service clubs, churches,

schools, scout groups, boys clubs, and hot-rod clubs are fertile fields for safety talks and films. A good safety education program not only sells traffic safety but as a by-product it sells the police.

Perhaps now is the time to talk about this *EDS*—"an essential ingredient of our product." EDS is as old as time. It is elusive as a rainbow—and can come and go as quickly.

Being a law enforcement officer is like teaching, nursing, social work, and several other professions: a public service. The honest law-enforcement officer has no prospect of appreciable dollar gain or of fame and fortune. He has only the satisfaction of rendering a service, that warming satisfaction of being helpful to someone, the gratification that comes from a job well done.

EDS

Any program of traffic control becomes effective only through a personnel *enthusiastic* for accomplishment, *dedicated* to an ideal, and *sincere* in effort.

However logical the enforcement procedure, however well-planned the traffic-control program and highly organized the department, it still remains for *people* to put it into practice. The program will succeed to the degree in which these people possess *Enthusiasm, Dedication,* and *Sincerity.*

Highway Studies in California

RANDOLPH COLLIER

State Senator Collier is Chairman of the California Senate Committee on Transportation, and Chairman of the California Senate Interim Committee on Highways, Streets and Bridges. He was first elected to the California Legislature in 1938. His previous articles in TRAFFIC QUARTERLY *appeared in July, 1947 and April, 1953.*

THE California Legislature has had one or more interim committees studying the highway problems of the state continually since 1945. In 1952 a joint legislative committee undertook a comprehensive review of needs on the state highway system. These studies culminated in recommendations leading to a substantial acceleration in the rate of financing improvements on the state system. Highway-user taxes were increased about thirty-three percent in 1953 and the entire revenue increase was allocated to the state.

Since 1953, the Senate Interim Committee on Highways, Streets and Bridges has been devoting its attention to the road problems of local governmental agencies. The committee's studies cover local road and street conditions of all cities and counties of the state. A complete inventory of existing critical deficiencies has been prepared.

Several reasons aroused this interest in local road deficiencies by a committee of the state legislature:

1) County roads and city streets are essential and integral components of a statewide system of adequate transportation facilities.

2) The California Legislature has allocated specified portions of state highway-user tax revenues on an annual basis to counties and cities. (In the fiscal year 1953–54, these allocations to the local governmental jurisdictions amounted to approximately $100,000,000.)

3) Since 1945, special emphasis has been given to the improvement of the state highway system because of its priority as a responsibility of the state government.

Special emphasis on improvement of the state highways since 1945 has made possible substantial improvements. While some attention was given to local road needs in highway revenue legislation since 1945, the bulk of state highway-user tax revenues has been concentrated on the state highway system. A large amount of deficiencies still exist, but overall improvement of the state system is well underway.

1954 Figures Exceed 1960 Forecast

The same factors of growth that created state needs and forced concentrated legislative attention on the state highway system have aggravated county road and city street problems. In the fiscal year 1953–54, the combined expenditures of cities and counties for road and street purposes amounted to $182,000,000. During the same year state allocations of highway-user tax revenues to cities and counties amounted to approximately $100,000,000.

These huge expenditures have been necessary to meet the needs of a growing state population for better county roads and city streets. In 1947, it was estimated that the population of California would be 11,100,000 in 1960 and that motor vehicle registrations would be 5,250,000. By July of 1954, population was reliably estimated at 12,450,000 and actual motor vehicle registrations were 5,716,000. Since 1947, motor vehicle registrations have increased sixty-two percent. California, by 1954, had exceeded the estimates for population and motor vehicle registrations that had been forecast for 1960.

I. Method of Study

The Senate Committee decided that its studies of local road and street needs should be restricted to *current* deficiencies. This emphasis on existing needs was necessary as a practical matter. There was almost complete absence of adequate and uniform information on existing problems. It was recognized that without a prior survey of existing needs an inventory of future needs would be quite impossible. The committee faced a number of problems:

1) A comprehensive study had never been made of county road and city street deficiencies.

2) Committee funds were not sufficient to support the total cost of a statewide study of these local road deficiencies.

3) In order to be of maximum value, county and city officials had to have confidence in the study.

The committee requested the County Supervisors' Association of California and the League of California Cities to appoint advisory committees of qualified representatives of both counties and cities. The county advisory committee was composed of a representative group of county road commissioners, and the city advisory committee was composed of both city engineers and city managers. Thus, statewide participation of both cities and counties was assured.

The functions of both advisory committees were similar. Every phase of the study was reviewed with these committees. They took part in the development of the forms to be used for the study so that they would reflect the individual needs of cities and counties. They were responsible in large measure for the specific standards of improvement used as basic guides for the determination of road and street deficiencies. In all matters related to the conduct of the survey, however, the Senate Interim Committee reserved final judgment.

Advisers Assisted Counties, Cities

After the instructions, forms and standards had been forwarded to each of the counties and cities by the senate committee, members of the advisory committee advised or assisted individual counties or cities in the preparation of their inventories of county road deficiencies or city street deficiencies when necessary. Also, on request of the Senate Interim Committee, the individual members of the advisory committees acted as agents of the committee in getting reports submitted promptly and in advising individual counties and cities as to the propriety of their individual reports. In this capacity, the advisory committees were instrumental in maintaining the uniform and consistent approach by the cities and counties in the preparation of the inventory.

The reports submitted to the senate committee included tables showing characteristics of the individual county road and city street systems. Every county and city submitted a map of the county or

city road system. The tabulations of critical deficiencies included the identification of the road or street, the length of the deficiencies in miles, estimated traffic counts on the deficient road or street, the reason for the deficiencies based on the standards established by the advisory committees, the description of the improvement required to correct each deficiency, the estimated cost of rights of way, and the estimated construction cost. Separate reports of a similar nature were made for bridges and grade separations.

The staff of the Senate Interim Committee made sample field audits of the deficiencies reported by both cities and counties. Based on these reviews, individual cities and counties were requested to make such revisions as appeared necessary to the end that all reports would be uniform and consistent with the objectives of the study.

To supplement its survey of county and city deficiencies, the Senate Interim Committee on Highways, Streets and Bridges also reviewed the manner in which all available funds were expended for road and street improvements and the extent to which *local* funds were made available. This phase of the study has isolated certain financing problems that relate directly to the extent of deficiencies.

In many local areas, excessive funds were used for maintenance rather than permanent construction. Local funds made available for road and street purposes by some cities and counties were less in 1953–54 than in 1947–48 despite growth in population and substantial increases in motor vehicle registrations. The inventory of deficiencies has indicated that present formulas for allocation of state funds to local jurisdictions should be reviewed in the light of needs and local resources.

The information on critical deficiencies and the use of road and street funds by the local jurisdictions has been published in reports of the senate committee. These official reports provide an avenue for bringing to the attention of the state and the individual cities and counties the extent of the local road and street problems. For many cities and counties this is the first time complete information has been made available.

The reports have been instrumental in stimulating interest of the local governmental jurisdictions in their own problems, the magnitude of which many of them did not appreciate heretofore. While leadership of the state legislature was necessary in this effort,

the results could not have been achieved without the close and enthusiastic cooperation of officials of the cities and counties of California.

II. Some Findings and Recommendations

The nature and methods of our studies have been described in some detail with the thought that other states having similar problems might derive some guidance. Some of the findings and recommendations may also be of general interest.

Current deficiencies on county roads are estimated at $592 million; on city streets $1,237 million. At current rates of expenditure over fourteen years on the average would be required to eliminate road deficiencies; over thirty years would be required to meet city street deficiencies. In seventeen of the state's fifty-seven counties, more than twenty years would be required to meet road deficiencies. In seventy-seven of the two hundred and fifty-eight cities reporting, over fifty years would be required to meet current street deficiencies.

It was also estimated by bringing up to date the 1953 survey that $2,984 million would be required to eliminate current deficiencies on the state highway system. Thus, total deficiencies on the entire highway, road and street network of California are in excess of $4,800 millions.

It must be emphasized that these figures represent *current* needs. This *backlog* must be eliminated if California is to have safe and efficient highway transportation. Future growth of the state and increased motor vehicle traffic will create many additional demands for highway improvement. The figure on highway needs in California—present and emergency—reported recently by the United States Bureau of Public Roads is $8,209 millions. The $8 billion figure reported by the Bureau appears to be conservative, in view of the fact that the careful and comprehensive surveys in California which we have just described indicate existing deficiencies of almost $5 billion.

The Senate Interim Committee has not yet made any broad specific recommendations for acceleration or changes in highway financing. It has made certain admonitions in regard to excessive expenditures for maintenance and equipment and the lessening of local tax efforts. It has recommended to both cities and counties

Table I

Estimated Cost to Correct State Highway, County Road and City Street Deficiencies by County

1954

County	State Highway Deficiencies	County Road Deficiencies	City Street Deficiencies	Estimated Construction Cost
Alameda	$ 240,443,000	$ 13,070,360	$ 93,598,103	$ 347,111,463
Alpine	3,309,000	218,500	—	3,527,500
Amador	5,318,000	922,000	—	6,240,000
Butte	22,530,000	2,327,000	1,934,014	26,791,014
Calaveras	7,136,000	1,482,500	—	8,618,500
Colusa	5,095,000	4,966,000	—	10,061,000
Contra Costa	88,272,000	34,875,800	22,483,395	145,631,195
Del Norte	8,624,000	1,002,400	241,600	9,868,000
El Dorado	14,993,000	3,798,150	271,194	19,062,344
Fresno	62,621,000	6,656,200	11,764,900	81,042,100
Glenn	7,117,000	345,000	120,000	7,582,000
Humboldt	47,066,000	27,390,530	29,500	74,486,030
Imperial	21,435,000	2,821,885	3,102,422	27,359,307
Inyo	3,939,000	1,295,820	41,200	5,276,020
Kern	82,303,000	8,391,000	10,716,607	101,410,607
Kings	15,127,000	4,261,150	858,100	20,246,250
Lake	6,694,000	1,554,550	—	8,248,500
Lassen	7,465,000	2,484,730	—	9,949,730
Los Angeles	753,632,000	153,217,690	830,078,803	1,736,928,493
Madera	13,112,000	10,564,090	263,500	23,739,590
Marin	17,288,000	8,054,460	3,225,530	28,567,990
Mariposa	2,567,000	2,352,250	—	4,919,250
Mendocino	41,936,000	8,116,800	581,350	50,643,550
Merced	36,827,000	26,600,920	2,231,917	65,659,837
Modoc	5,869,000	2,025,700	454,068	8,348,768
Mono	7,043,000	1,074,500	—	8,117,500
Monterey	48,784,000	4,076,050	6,723,567	59,583,617
Napa	10,338,000	10,327,500	1,471,662	22,137,162
Nevada	27,005,000	2,952,850	—	29,957,850
Orange	87,352,000	12,641,129	11,025,147	111,018,276
Placer	27,317,000	7,971,400	587,944	35,876,344
Plumas	7,616,000	3,692,094	40,500	11,348,594
Riverside	63,782,000	11,949,940	8,392,204	84,124,144
Sacramento	113,054,000	20,625,800	7,669,718	141,349,518
San Benito	6,836,000	4,661,620	381,241	11,878,861
San Bernardino	89,803,000	14,362,400	12,626,229	116,791,629
San Diego	132,810,000	26,091,305	61,654,754	220,556,059
San Francisco	138,061,000	—	27,050,000	165,111,000
San Joaquin	59,824,000	25,270,354	15,564,520	100,658,874
San Luis Obispo	35,096,000	13,869,250	668,300	49,633,550
San Mateo	81,025,000	8,233,475	25,909,565	115,168,040
Santa Barbara	36,868,000	4,362,535	3,694,600	44,925,135
Santa Clara	100,273,000	6,984,900	39,899,769	147,057,669
Santa Cruz	20,177,000	2,853,000	3,264,153	26,294,153
Shasta	26,174,000	8,873,412	1,303,857	36,351,269
Sierra	3,791,000	583,800	13,000	4,387,800
Siskiyou	19,657,000	1,176,200	707,993	21,541,193
Solano	57,517,000	14,832,000	5,497,075	77,846,075
Sonoma	53,814,000	5,697,450	2,953,450	62,464,900
Stanislaus	33,739,000	15,328,657	7,453,740	56,521,397
Sutter	13,212,000	1,512,700	208,000	14,932,700
Tehama	17,614,000	1,099,500	1,554,928	20,268,428
Trinity	7,008,000	7,164,400	—	14,172,400
Tulare	35,688,000	16,259,837	2,903,104	54,850,941
Tuolumne	10,656,000	651,000	576,000	11,883,000
Ventura	48,619,000	1,038,975	1,591,720	51,100,775
Yolo	32,067,000	3,124,200	1,898,910	37,090,110
Yuba	11,016,000	4,208,350	258,471	15,482,821
Totals	$2,984,354,000	$592,146,018	$1,236,614,824	$4,813,114,842

that provision be made for annual reports on highway progress, needs and revenues.

It has recommended also that the state highway division make provision for detailed inventories and planning surveys of city streets, just as it now does for county roads. It has recommended further that the legislature follow the pattern previously established with respect to county road administration and financing, by providing specific funds to be used exclusively for city street engineering purposes. By this means, the legislature will have clearly established its intent, on a uniform basis for all local jurisdictions, that properly engineered and wisely administered local roads and streets are essential components of an adequate statewide highway transportation network.

Connecticut's In-Service School for Motor Vehicle Inspectors

WALTER J. MAYO

Walter J. Mayo has been Chief of the Division of Investigation and Inspection of the Connecticut Department of Motor Vehicles since 1950. He joined the Connecticut State Police in 1928. In 1940, he attended Northwestern University Traffic Institute for a course on Traffic Control and was subsequently assigned to the Traffic Division of the State Police in Hartford, Connecticut, where he remained until coming to the Motor Vehicle Department in 1942 to become Chief Inspector.

CONNECTICUT, a small state with dense population, has a long history of motor vehicle control. Her first speed law was passed in 1901, first registration issued in 1903, and the first operator's license in 1907. Connecticut has 1,000,000 licensed motor vehicle operators for her approximately 2,000,000 population, (1950 census). Each year sixty inspectors examine from 75,000 to 100,000 applicants for driver-licenses. In 1954, fatal accidents totaled 228—and 241 persons were killed.

Connecticut has required examinations for driver license since 1917 when the motor vehicle department was established, with Robbins B. Stoeckel as the first motor vehicle commissioner. Immediately the training of examiners became of first importance, but methods of training needed to be worked out and standards for inspectors established.

Not to Teach Applicants to Drive

Thirty years ago Mr. Stoeckel wrote in a department bulletin that although an applicant's literacy can be determined from his application, and his knowledge of the laws discovered by asking him questions chosen from a long list, "the examiner has to form a rough and ready opinion of the general intelligence of an applicant . . . meeting him in a friendly and interested manner. On the road test the judgment and discretion of the examiner are invaluable. He should be willing to assist and instruct the applicant who has made a

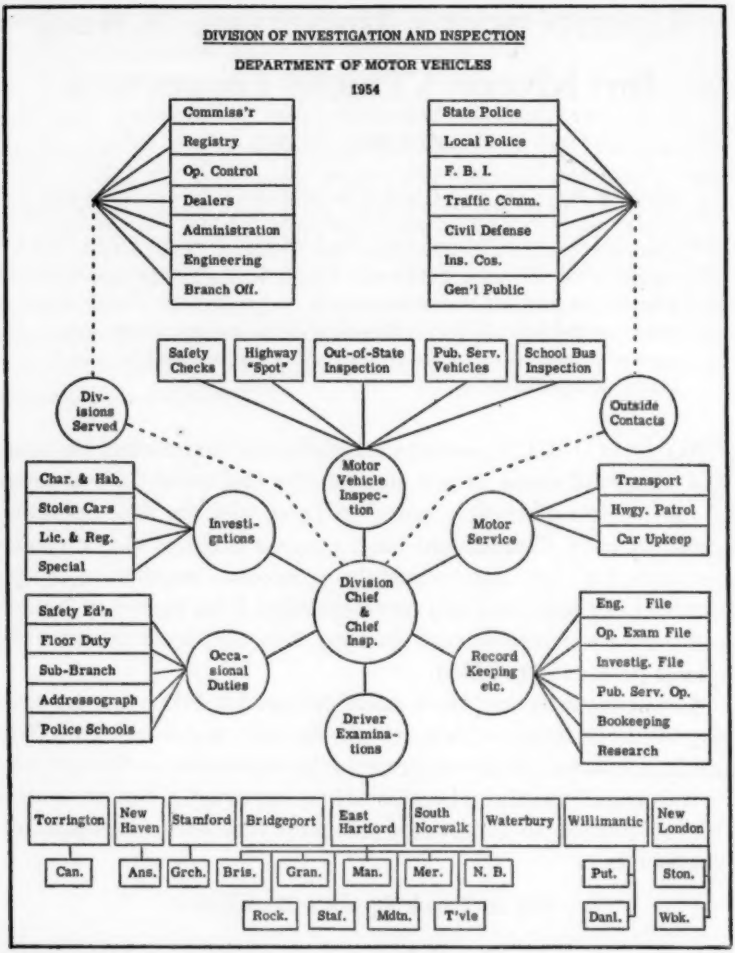
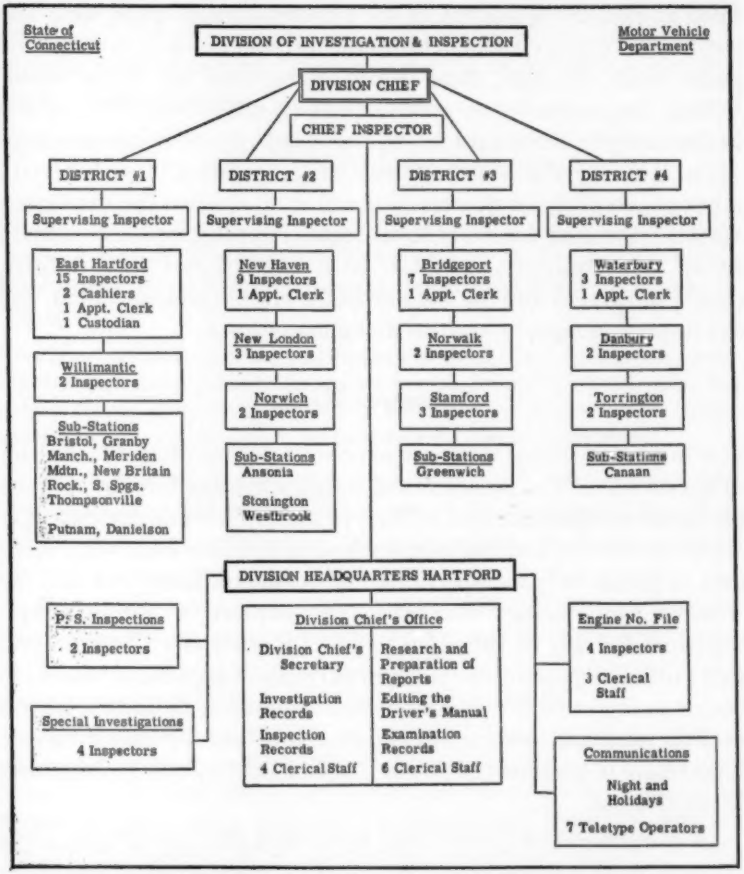


Chart Shows Duties of Employees, Division of Investigation and Inspection, 1954.

slight slip through nervousness, but in a general way the time of the examiner ought not to be spent in teaching applicants to drive. An examiner is there to discover whether they can drive."

Through the years these standards have continued to be those on which the examination is based. From time to time, special efforts were made to increase the judgment and discretion of the examiner



Geographical Distribution for Division of Investigation and Inspection, 1955.

and to help him in forming an opinion as to the general intelligence of applicants and as to whether they can drive, all being done in a "friendly and interested manner." The most recent effort was the In-Service School held in the beginning of 1954. This was so successful that one of the first acts of Commissioner John J. Tynan, whose term began in March, 1955, was to call for another school, along slightly different lines, for the fall of 1955.

The work of inspectors, even in the early days, was never con-

fined to examining applicants for a driver-license. They were also required to inspect motor vehicles, to carry on investigations and do patrol work. In 1921, these duties, along with the entire motor Vehicle Inspection Force, were turned over to the State Police which had recently been reorganized, and not until 1931 were examinations again given by the Motor Vehicle Department, although certain other phases of the work were returned in 1929 when the Inspection Section (now the Division of Investigation and Inspection) was again set up. This continues to be a division with varied responsibilities, closely integrated into the work of all the rest of the department, and the inspectors must be trained along many lines.

Inspectors' Duties

Few inspectors devote their entire time to any one phase of the work of the division. The same man, although spending most of his time giving driver examinations, is likely to spend a week or two each year on school bus inspections, to investigate cases in his immediate territory, to go out on spot inspections, and during the slack period in the winter to work in the tabulating section running an addressograph machine. He may be called on to go to another office because of a particular need such as an unexpected rush of applicants, and he is bound to report traffic violations when he observes them as he travels over the state and to warn the operators involved. He may even find it necessary to exercise the power of arrest held by all the inspectors of the division.

The inspectors serve all other sections of the department. They investigate for the suspension section, they collect licenses and registration plates for the billing section, and during the renewal rush, they carry salary checks to the branch offices for the payroll section. Their contact with state, local and federal enforcement agencies is likely to be close, because of the search for stolen cars through the engine number file, on which two or three inspectors are constantly working. Occasionally they assist local police in handling crowds and traffic, and in the civil defense program each man has a post.

Many of the inspectors are called on to give talks on the work of the department to groups of various size, police-recruit training schools, service clubs, P.T.A., schools and young people's organiza-

tions. Experienced in many phases of the department's duties they are specially fitted to explain its functions. Most employees know only the work of one section—the inspector must know something about all other sections.

Selecting and Training New Men

An inspector's preliminary training begins before he is employed by the state, because the job specifications set up by the state personnel department for the examination for motor vehicle inspector read as follows:

"Not less than four (4) years' employment in the sale or operation of motor vehicles or in investigatory or regulatory work involving contact with the public OR graduation from high school and two (2) years' employment of the above type OR an equivalent combination of experience and training."

Candidates must be between the ages of 25–48; hold an operator's license; have a good motor vehicle record; pass a physical as well as written and oral examinations. Of 106 qualified candidates accepted for the most recent examination for this position, nine passed.

Once the inspector has been engaged on a provisional basis his training by the department begins. First comes intensive instruction in the Hartford office, then a period of roughly two months under constant supervision by one of the senior inspectors.

First Week: After conference with the Chief Inspector and the Division Chief, who outline general principles of the work, he is given the "Connecticut Driver Test" to study, also outline of the "Inspection Section." Some time is spent in the offices of the Division of Investigation and Inspection, where he is instructed in paper work illustrated from "The Connecticut Driver Test" and from actual reports received while he is in the room, and is shown working of files that concern examination records. The rest of the week is spent with examiners in the East Hartford office, observing their methods of work, especially the giving and grading of the eye-test and the written test, and learning some of the problems of dealing with the public.

Second Week: Observation of paper work continues, with opportunity to give tests for *vision* and *laws* and occasional opportunity to accompany an experienced inspector while giving road-tests.

Third Week: If new inspector is to be stationed in Hartford, he is sent to the inspection lane, first to observe procedure, and then for the actual conduct of inspections, being stationed there for at least a week. If he is destined for

another part of the state, he spends only a short time at the lane, continuing his instruction after arriving at his permanent station, where he will be trained in *school bus* and *spot inspections*. Before reporting to his station, the new recruit is given a tour of the department to become familiar with its operation.

Fourth Week: For at least a month the new inspector continues to give tests only under instruction. The supervising inspector of his district discusses his work with him and with the inspectors directly instructing him. He still does not give complete driver tests, but is allowed to "write up" the applicant and give the road-test, although the final responsibility is given to the experienced inspectors who sign applicants' affidavits.

The date at which training in investigations begins depends upon the pressure of work of examining and inspecting, and upon the need for making investigations immediately. The new inspector accompanies an experienced man on a number of trips, observing his method of interviewing and the general manner of conducting investigations. An effort is made to see that he goes out with various experienced inspectors before his training is over, in order that he may learn different techniques. In from two to three months, depending upon the report of the Supervising Inspector, the new man is given a uniform, authorized as a notary public, and is considered a full-fledged inspector and no longer a trainee.

Continuous Training

The inspector's training cannot stop when his appointment ceases to be provisional. Because he often works entirely alone, he frequently is informed of changes in department rulings or procedure, and the results of his work are checked with great care. He is constantly dealing with other people—the public—and often he is the first member of the state service with whom these people come in contact. In his person he represents the State and his actions are closely observed. Therefore the department keeps closely in touch with every inspector, whether or not he can come to Hartford more than once or twice a year.

The same standards must be observed in all parts of the state: improvements in one place must be reflected state-wide; errors must not be allowed to become habits; healthy rivalry between districts must be encouraged but not to excess. An attempt to accomplish this is carried out through a system of weekly conferences between the chief inspector and the four district supervising inspectors. The supervising inspectors bring problems that arise in their respective dis-

tricts, and take back information of new plans and procedures. In this way, through constant discussion of problems in different places, a reasonable measure of uniformity is maintained.

Inspectors do varied work and exchange posts, so that each becomes capable of substituting for another—sometimes giving examinations, inspecting motor vehicles, or making investigations.

This system of supervisors' conferences, supplemented with memoranda and field trips by the chief inspector and the division chief, keeps the men abreast of day-to-day changes in procedure. Now and then, all inspectors come to Hartford for special instruction, when changes in the law test are instituted, when a new form of eye-testing equipment is installed, and recently when the license-expiration date was changed. Every few years a more formal in-service school lasts for several days. Previous schools took place during the commissionerships of Michael A. Connor, John T. McCarthy, and Elmer S. Watson. The most recent was held in January, 1954, with Commissioner Charles F. Kelley presiding.

1954 Inspectors' School

For four consecutive weeks, beginning January 12, 1954, the Connecticut Motor Vehicle Department held sessions of a school for inspectors. Each week a different group of fifteen inspectors attended for three days in well-appointed classrooms of the Connecticut National Guard at Brainard Field, Hartford. Each section of the state was represented at each session of the school. The first group included all the supervising inspectors, practically all senior inspectors, and many others of long service in the department. The later groups were made up of less experienced men, except for those who had of necessity been left in charge while the first group was at school. The program was the same for each of the four schools. The following outline shows the extent of the schedule:

The first day of each school was devoted chiefly to the subject of *driver examinations.* Welcoming remarks set forth the purposes of the school—primarily to obtain greater uniformity of procedure throughout the state, to raise the standard of examination, and to improve the relations between the motor vehicle department and the public.

After the introductory remarks a talk on *"Driver Selection"* was given by

a representative of the Connecticut Safety Commission, who emphasized the importance of an inspector's influence at a road-test and the necessity of trying to make sure that the applicant's attitude was one to help the cause of safety.

Following this address, a training specialist from the State Department of Education, led a discussion on *public relations*. This varied slightly from one school to another, as the leader brought out from the inspectors themselves definitions of public relations, causes of poor handling of the public, and ways to remedy them. At the end of this discussion, the ice was broken, and the inspectors seemed eager to share in future question-and-answer periods.

Later in the morning one of the officers of the Connecticut Optometrists Association spoke on "How We See," touching main phases of the vision test given for driver-licenses. He explained that too frequently the applicant's ability to score on the visual test may be influenced by his emotional tension, and that if the inspector has any question as to the applicant's ability to pass the test, he should be careful not to diagnose the reason for failure, but should refer the case to a specialist, as this may mean much for the applicant's future vision.

The first two hours of the afternoon were taken up with class sessions on *the applicant and the application* under the direction of the chief inspector. Here again the class took an active part. Inspectors acted out the role of applicant and examiner. One team showed a timid applicant and a gruff inspector; another illustrated the belligerent attitude of an out-of-state applicant who resents the examination. The cases were discussed and better ways of handling applicants were suggested. There was a certain amount of instruction as to errors frequently found in the inspector's paper work, and samples were shown to bring the facts home.

The day ended with a session on *driver education in the schools,* in charge of members of the State Department of Education and of the Motor Vehicle Department, both assigned to the driver training program. The growth of driver education in the schools during the last four years was pointed out, and the requirements for a teacher of driver education, as well as the requirements for students, were set forth. Inspectors were urged to be particularly careful in testing students to make sure they actually are better drivers than the average.

The second day was chiefly concerned with the *motor vehicle law.* An officer of the state police department and the chairman of the Connecticut Assembly of Municipal Judges alternated in opening talks at these second-day sessions.

Each speaker spent much time discussing the *rules of the road* and their interpretation, particularly urging reasonable speed.

The state police officer spoke of the difficulty of determining whether an operator had broken the law at the time of an accident, and also discussed the difficulty of pressing a charge when it came to court.

The judge discussed the *court system in Connecticut* and the four areas of

life involved in law enforcement. All four concern an inspector. We try to present *deterrents, so that The Offense May Not Be Committed By Anyone Else.* The departments are:

1. Before an offense occurs
2. Arrest, investigation, etc.
3. Trial in court
4. After disposition in court

He outlined *"How to be a Witness,"* which was praised especially by those new to the witness stand:

1. Know your facts, bring diagrams, etc.
2. Speak so you can be heard
3. Give short answers
4. If you don't know, say so
5. If you don't understand, say so
6. Never show any feeling or prejudice
7. Be on the formal side—do not use first names

The second subject on Wednesday was an enlightening description of the workings of the New Financial Security Law, or *Accident Security,* as it is called in Connecticut, given by the Chief of the Operator Control Division at the first school, and at later schools by the Chief Evaluator. A comparison was made between the Compulsory Insurance Law and the Financial Responsibility Law, showing that in Connecticut it was possible to choose whether one carried insurance. It was explained that anyone involved in an accident must file proof of financial responsibility, whether or not he is responsible. Because the inspectors have much to do with picking up licenses and registrations from persons failing to file proof, there was considerable discussion of the subject, and details as to procedure cleared up.

The subject of *accident security* led to the matter of *investigations,* and the chief inspector took charge of the class on the routine to be observed when making inquiries, collecting licenses, etc. A written routine was given to each inspector, discussed in class, and a number of questions were raised and answered about specific problems brought up by the inspectors.

A list of places from which information can frequently be obtained when making investigations was prepared, members of the class making suggestions.

In the afternoon, a supervising inspector described the institution of the *appointment system for examinations* in his district. He outlined the procedure necessary before the system was installed, outlining its significance once it was begun. He considered it an improvement on the old way of giving examinations. He said it prevented over-crowding the examiners. Expected difficulties did not appear.

A class session in charge of the chief inspector took up giving the *law test and the road test.* Inspectors were divided into three groups, each of which

worked out what seemed the proper points to observe on the road test. Results for each group were discussed at length by the chief inspector, with assistance from the class. It was interesting to observe the likenesses and differences between the results of the discussion by groups.

In the final hour of the day, the Chief of the Division of Engineering, explained *motor vehicle laws passed by the 1953 legislature.* New law books were distributed to the inspectors, and a mimeographed outline of the new laws, their statute numbers and the pages on which they could be found.

The last day of each school was devoted largely to matters concerning the Inspection of Motor Vehicles. The day opened with a discussion of the *stolen car problem.* Various types of car thief were discussed: joy-hoppers who can be foiled if you lock your car; those who take a car to make a get-away; those who use phony checks, and professional car thieves. The leader described ways in which engine numbers have been altered and how to detect alterations. He urged all inspectors to become familiar with what good numbers look like, to recognize phony ones. In the out-of-state inspection, it is most important to check the numbers correctly, because no state provides as much opportunity to thwart car thieves as in Connecticut, through our *engine number file.* But the file is only as good as the inspection of the engine numbers.

Class sessions on the *engine number file* and the out-of-state inspection followed, led by the chief inspector, assisted at times by inspectors who work in the number file. He stressed the importance of making a *physical* check of the engine numbers, not trusting to the registration. If a number is mutilated, the inspector can hold the car. The engine number file is flagged for stolen cars, and during the last year almost a hundred have been recovered. The file is constantly in use by state, local and federal, as well as private, agencies.

As a suggestion of the inspectors a new form of record sheet was adopted for inspection stations in keeping a record of cars examined.

Spot Inspection and School Bus Inspection was the next subject, again in charge of the chief inspector. Errors in making reports of inspections were discussed. Samples were shown of good and bad reports.

The last hour of each course before the final summing up was a second discussion group on *public relations,* led by the same member of the Department of Education who had spoken earlier. This talk picked up the subject where it left off on the first day, but because of all that had gone on since that day, the inspectors approached the matter from a different angle. At first they had been new as a group—now they were welded together through common experiences of the three days.

A specific case-situation was brought forward—how to handle a man from out-of-state who resented the necessity of taking a law test. First the cause of his resentment was considered—then possible solutions of the problem. The final points brought out in regard to the sphere of public relations were: What we do; what we say; how we say it and when; how we look at ourselves.

The leader suggested that inspectors look at themselves as *Service Salesmen*, but members of the class added *Safety Salesmen*.

Each school was closed, as it began, with a few words from the Chief of the Division of Investigation and Inspection, encouraging the men to greater efforts to improve the work of the division, and promising the support of himself and the Commissioner.

Comments on the School

The foregoing outline brings out the point that this was not a mere series of speeches by distinguished visitors, nor a formal teacher-and-pupil classroom presentation of "thus shalt thou do." Of course necessarily there was much instruction, both written and oral; and there were speakers able to enlighten the class along special lines. The atmosphere was that of a workshop. Students shared in discussion, offered suggestions, and brought out their problems.

Reactions of the inspectors were rewarding. Older inspectors said: "This was the best school we ever had." Among newer men, the remark usually was, "We ought to have schools like that often." Several of the leaders have spoken of how responsive they felt the groups to be. The first school, with the most experienced inspectors, was as appreciative as the last one, in which most of the inspectors were comparative newcomers. A real impetus was provided for fuller development of the work of the division and of morale among its members.

Such a conference can only be a success if carefully planned, not only as to speakers but also as to the preparation of printed or mimeographed material to be distributed. If a kit is handed out, it should have a table of contents, and each piece of material should be numbered for ready reference during the school. A binder should also be provided, with pencils and note-paper, and it is of great advantage to have a blackboard. Reasonably frequent breaks are important, with the windows open, when the men can move around, talk and smoke. Otherwise their attention is likely to stray, for they are accustomed to out-door activity. It has been found that when inspectors take part in the discussion they contribute much, and their own after-comments show that they find such discussions of value.

One other point must be emphasized. This school could not have been the success it was, had it not been for the devoted work of the

chief inspector who drew up the program, presided at every session, and himself led all discussions dealing with procedures of the division of investigation and inspection. During the last two years he attended the schools for chief inspectors under the auspices of Northwestern University, one at Boston, Massachusetts, the other at Evanston, Illinois.

It is impossible to say what has been the effect of the school. The morale of the inspectors was improved; they understand better some of the problems of the department. But morale does not come overnight—it is the result of accumulated experience on the part of the department as well as the men who build it. Not this school only but those that preceded it—driver clinics, special studies, the research programs carried on through the years—these, with constant supervision, have built up a store of shared knowledge and experience that makes the Connecticut inspector look on his work as something worth doing. Therefore he does it well. This fact is recognized by the National Safety Council which has twice awarded Connecticut special recognition for its work in driver-licensing.

MATERIAL DISTRIBUTED DURING INSPECTOR'S SCHOOL

DEPARTMENT OF MOTOR VEHICLES

STATE OF CONNECTICUT

1954

Examinations:

"The Connecticut Driver Test" (used as Text-Book)
Notes on Routine of Reporting in Current Examination Procedure
"Training Handicapped Operators on Dual Control Car"
Examination Statistics, 1953
Information for 16–17 Year-olds

Inspection:

"Standards for Inspection, 1953"
Brief on Equipment Laws
Reporting Procedure for Out-of-State Car Inspection

Investigation:

Notes on Routine of Reporting Investigations (with forms currently in use)
Pointers for Making Investigations

Eye Test:

"Connecticut Operators and the Eye Test"

School Driver Training:

Copies of all Forms Currently in Use
Outline of Procedure
Statistics for 1953

Accident Security:

Accident Report Form
Requirements for Accident Security
Forms used by Inspectors

New Motor Vehicle Laws:

Summary of M. V. Laws passed by 1953 Legislature
New Law Book
New Driver's Manual

A CHRONOLOGICAL RECORD OF DRIVER LICENSE EXAMINING IN CONNECTICUT

1907 *First year Operator License required,* good for one year from date of issue. *All operators must be 18 years of age.* No examination given, but number of miles previously driven was asked.

First suspension and revocation law went into effect.

(NOTE: *The first Speed Law was enacted in 1901,* and the *first Registration of a Motor Vehicle was issued in 1903.* Registrations, and later Operator Licenses, were handled through Office of State Secretary.)

1909 *Licenses to expire on last day of February annually.* (This was so that License Year would be different from Registration Year, which ended December 31st.)

1917 *Motor Vehicle Commissioner appointed,* and took over Motor Vehicle duties from office of Secretary of the State.

Examination for Driver's License required: Driving, Law and Reading Tests given. Age limit, 18 or over. All persons already holding licenses (98,233 in number) were "frozen in." Examination form was discretionary with the Commissioner, as it still is; but law stated, as now, that applicant should "demonstrate personally . . . that such applicant is a proper person to operate a motor vehicle, has sufficient knowledge of the mechanism of motor vehicles to insure their safe operation by him, and a satisfactory knowledge of the laws concerning motor vehicles and the rules of the road." (Note: Wording slightly changed from original).

Motor Vehicle Department Inspector appointed, who gave the examinations, until 1921 when examiners were transferred to State Police Department.

1921 *Examining for Driver License taken over by the State Police.*

1923 *Eye-Tests given to a sampling of operators with accident records.*

1927 *Eye-Tests begun as part of the regular Operator's License Examination.* The standard was 20/70 with both eyes, either without glasses, or, if necessary, when wearing glasses.

Restriction required if glasses needed to pass test.

Licenses extended to 16–17 year-olds, with proviso as to parent's consent and the filing of proof of financial responsibility according to the requirement set by the law.

Manual for Motorists issued for the first time. This was a detailed explanation of the laws regarding license and registration, financial responsibility, reciprocity, traffic control, penalties for various offenses. It was easier to understand than the Motor Vehicle Law Book, which had before this time been the only instruction book; but it was still much too complicated for the average driver.

1929 *Special Tests given to handicapped drivers* by Motor Vehicle Inspectors, although regular testing was left to State Police.

1930 Experimental written tests along psychological lines given to selected groups in cooperation with Yale University's Institute of Human Relations. Original so-called "Psychological Test" given to two sets of operators—one having good records, the other with high accident frequency records.

1931 *Examining for Driver License returned to Motor Vehicle Department.*
Further written tests developed with cooperation of Institute of Human Relations. Tried out, but took too long to administer. Questions were most of them adapted to Oral Law Test, however.

Letter sent to M. V. Dealers and others teaching Driving, in order to acquaint them with the new stress laid on law test, and stressing proper preparation of applicants. List of law questions likely to be asked and an outline of typical road-test included with letter.

New and more more stringent system of selection of Public Service Operators set up. Examination for bus operators begun.

1932 *New Handbooks* for Operators and for Public Service Drivers prepared, somewhat less complicated than before.

1933 *"Connecticut's Driver Test" an outline of the Examination, first issued.*

Full Reciprocity between states. Out-of-state license now permits visitor to operate any properly registered car in Connecticut. Previously a Connecticut license was required in order to operate a Connecticut car.

1935 *Minor's License* (for those aged 16 and 17) limited to the operation of cars insured to the amount required by financial responsibility act. The filing of proof of financial responsibility because of this was no longer required, as the license itself states the limitation.

Passing mark for eye-test changed from 20/70 to 20/40 in order to agree with standard of New York and Rhode Island.

Law test of twenty questions instituted. Mimeographed copies distributed in order to educate applicants.

Expiration date of licenses changed to April 30th. (Registrations to expire in February.)

1936 *Simplified Driver's Manual, called "Facts," issued,* including list of questions on laws, and with illustrations. With minor changes this has been re-issued when needed ever since. This was the first illustrated Manual of this type issued in the country.

Five test of 15 questions each set up for oral law-tests—the questions being taken from "Facts."

Color Test begun, using colored cards.

Special Review Examinations of operators with poor records instituted.

1937 *Law Test and Road-Test waived for applicants holding proper School Certificates* showing that they had passed either one or both tests in school.

Drivers' Clinic held in cooperation with Highway Research Board, Iowa State College and Harvard Bureau of Street Traffic Research. Various tests of vision, reaction time, etc., were tried out on a large group of operators, using a number of different procedures.

1939 *New Type License—with Identification Plate* accompanying it. Plate was metal during first few years—later cardboard was substituted)

1941 *Portable fluorescent eye charts* instituted for eye-test. Include colored lights for color test.

Road test waived for applicants holding current licenses in other states where examination is similar to Connecticut's. Inspector to use his own judgment, however, in deciding whether applicant should be examined—as in the case of elderly or physically handicapped or obviously unstable persons. Law Test and Eye-test required as usual.

1945 *Dual-control car used for the instruction and testing of handicapped* veterans (amputees and paralysis cases). Use of car for civilian handicapped applicants has been continued, to determine type of special equipment required and whether applicant is capable of being trained to drive. One inspector is assigned to this work, thus standardizing it greatly.

1948 *Driver Clinic held in cooperation with New York University Center for Safety Education,* using a number of tests and techniques. Partly as a result of this experiment the Department's own Driver Clinic was begun.

1949 *Finger-printing of Public Service Operators begun.*

1951 *Written law-test instituted, using multiple-choice questions.*

1952 *New eye-testing equipment installed*—tests for depth perception, imbalance, field of vision, color vision as well as acuity.

1954 *Appointment System for Examinations.*

Ways to Safeguard the Motorists in Areas of Construction

C. A. GOODWIN

Since 1948, Mr. Goodwin has been Traffic and Transportation Engineer for Liberty Mutual Insurance Company in Boston. He attended the Yale Bureau of Highway Traffic as an Automotive Safety Foundation Fellow, 1948–49. From 1940–47, Mr. Goodwin served as a transitman and assistant grade crossing engineer, Maintenance of Way Department of the Boston and Maine Railroad. He is a member of the Institute of Traffic Engineers and the Highway Research Board.

THE GROWTH in passenger car travel in recent years has limited the capacity of most highways. Any interruption of this intense travel flow, due to highway construction or maintenance operation, must be compensated for by alternate routes, either through or around the job site.

Such rerouting must be as safe and expeditious as possible with every effort made to inform, guide, and protect the traveling public. Otherwise, high accident frequencies with heavy losses may result, particularly because of:

a. Collision with construction equipment
b. Collision with other vehicles
c. Driving into open excavation work
d. Driving into work areas
e. Loss of car control because of soft shoulders, windrows and minor road conditions
f. Pedestrians falling into open excavations

Provision of adequate detours, barricades, directional and warning signs at or near a job site represents fulfillment of a public responsibility by road contractors, public utility companies, and public works departments as defined by law. The degree of requirements for these control and protective devices may vary by state or city, but the general liability remains.

Standards and recommended procedures outlined here are based on widely accepted practices and are intended as a reference guide only. It is suggested, before any road work is undertaken requiring installation of detours, barricades, and signs, that they be designed to conform with local, county, state, or federal regulations.

The "Manual on Uniform Traffic Control Devices" published by the Public Works Administration, Washington, D. C., is used by most states as the standard for installing street and highway control devices. The Engineering Committee of the National Safety Council's Construction Section is developing Highway Construction Safety Standards that supplement the available control standards.

Normal safety rules in use by contractors, utility companies, and public works departments to minimize normal hazards incidental to road work, are not covered in the discussion. Administrators would delegate responsibility to supervisors for full employee compliance with safety rules.

Road Building—Closed to Traffic

The most comprehensive type of public traffic control and protection is required in cases of complete shutdown of roadway sections for reconstruction or maintenance. Such work may be necessitated because of pavement washouts, curve elimination, bridge collapse, laying of new base and surface courses, road widening, or other major reasons.

Closing of a roadway section to public traffic carries with it the obligation to provide an alternate route, or detour, to assure completion of vehicular trips from origin to destination with minimum delay and maximum safety.

Selection of Detour: Whether the roadway section to be closed is rural or urban, extended or short, the alternate route, or detour, selected to replace it should meet two conditions.

1. Completely bypass the section of highway closed, yet provide access to residences and business if previously served via the original highway.

2. Possess the ability to absorb and otherwise accommodate the majority of diverted traffic volume without unreasonable delay, restriction or hazard. This ability, of the detour, known as "possible

capacity" will be determined by the volume and composition of diverted traffic, roadway alignment, number and widths of available lanes and desired vehicular speeds.

Installation of Control Devices: Three general parts of a detoured road project require informational guides and traffic controls; namely, the approaches, the beginning and end of the closed roadway section, and the detour route itself.

1. *Rural Detours:* Figure 1 illustrates a typical rural detour route selected to provide a long-term run-around for a highway project. This example represents an extensive section of highway closed for reconstruction. Because two small towns are included along the closed highway section, the detour route must connect with feeder roads to each town. Such an extensive detour might be necessary because of laying new base and surface courses, multiple road washouts, multiple grade crossing eliminations, incomplete expressway section.

Minimum requirements, by location and type of each traffic informational and protective sign and device are discussed below for approach, extremities and detour route.

(a) *Approaches:* Every effort should be made to warn and slow down the driver at least 1500 feet in advance of the closed roadway section. Such information as to speed reduction, road closure, and change of route, can best be accomplished by distinctive signs, easily understood *by the traveling public,* and reflectorized for night visibility.

Taking Figure 1 as an example, 1500 feet in advance of the work area, an oversized diamond-shaped sign at least 42 by 42 inches informs the driver of CONSTRUCTION AHEAD. The next traffic control is a double sign placed 1000 feet from the job extremities telling the driver to slow down to 15 MPH and turn off on the temporary route 1000 feet ahead. At a point no less than 300 feet nor more than 500 feet from the end of the closed road section, a third sign should read BARRICADE AHEAD.

If a US or State Route number is assigned to the traveled roadway, and interrupted by the road closure, an additional sign should be posted within seventy-five feet of the point of route change, clearly indicating the turn.

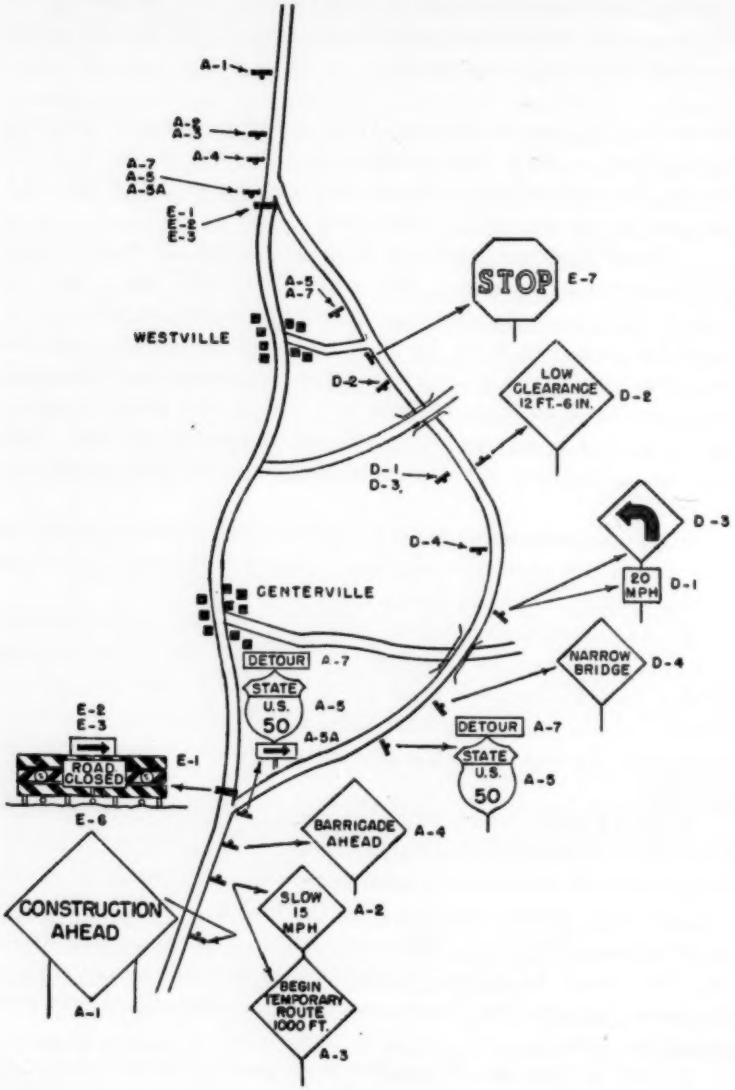

A-1
A-2
A-3
A-4
A-7
A-5
A-5A
E-1
E-2
E-3
A-5
A-7
WESTVILLE
STOP
E-7
D-2
LOW CLEARANCE 12 FT.-6 IN.
D-2
D-1
D-3
D-4
D-3
20 MPH
D-1
CENTERVILLE
DETOUR
A-7
STATE
U.S.
50
A-5
A-5A
NARROW BRIDGE
D-4
DETOUR
A-7
STATE
U.S.
50
A-5
E-2
E-3
ROAD CLOSED
E-1
E-6
BARRICADE AHEAD
A-4
CONSTRUCTION AHEAD
A-1
SLOW 15 MPH
A-2
BEGIN TEMPORARY ROUTE 1000 FT.
A-3

FIGURE 1.

The final precautionary measure to be taken at the approach is the removal of any center or lane line markings leading into the job extremities or points of closure. Such pavement lines should be diverted to lead into the detour route, as a guide for turning traffic.

(b) *Job Extremities:* The final control device before a motorist turns onto the detour route, is the barricade across the roadway and shoulders that excludes all traffic. With sufficient advance warning, no difficulty should be experienced by the approaching driver in comprehending the purpose of the barricade.

To exclude all through-traffic, barricades should be erected *entirely* across the traveled way and shoulders in fence form and be recognizable by distinctive markings as diagonal striping in contrasting colors with wide horizontal railing, together with large red reflectorized disks. In addition, flare pots, lanterns and other illuminating devices are absolutely an essential supplement during hours of darkness, storm or other periods of reduced visibility. The importance of advance warning of road blocks, and careful attention to construction details, is emphasized by the following accident case history:

A road contractor was constructing a portion of a new parkway, not yet open to public. At the end of his part of the work, he set up a barricade of steel drums and bales of hay. Just short of the makeshift barricade, a side exit was used by construction personnel to service equipment to the job.

An employee of a pipeline construction outfit, working in the area, but having nothing to do with the road construction, was operating a small pickup truck on the incompleted parkway; apparently he was suddenly faced by the barricade and being unable to negotiate a safe entrance with the side exit, lost control of the truck, crashed, and was instantly killed.

It was charged that the road contractor in assuming the obligation of barricading his portion of the work used drums and bales of hay, both inadequate and misleading. His negligence was established on the basis of other contractors' working in the area using standard, wooden rail barricades with distinctive painting.

(c) *Detour route:* Since the detour route is, for all practical purposes, an extension of the existing traveled way, it must, necessarily duplicate the characteristics of the original route as much as

possible. As mentioned above, the detour must bypass the closed roadway section, yet provide access to adjacent residences, and it must accommodate the majority of diverted traffic without delay or hazard.

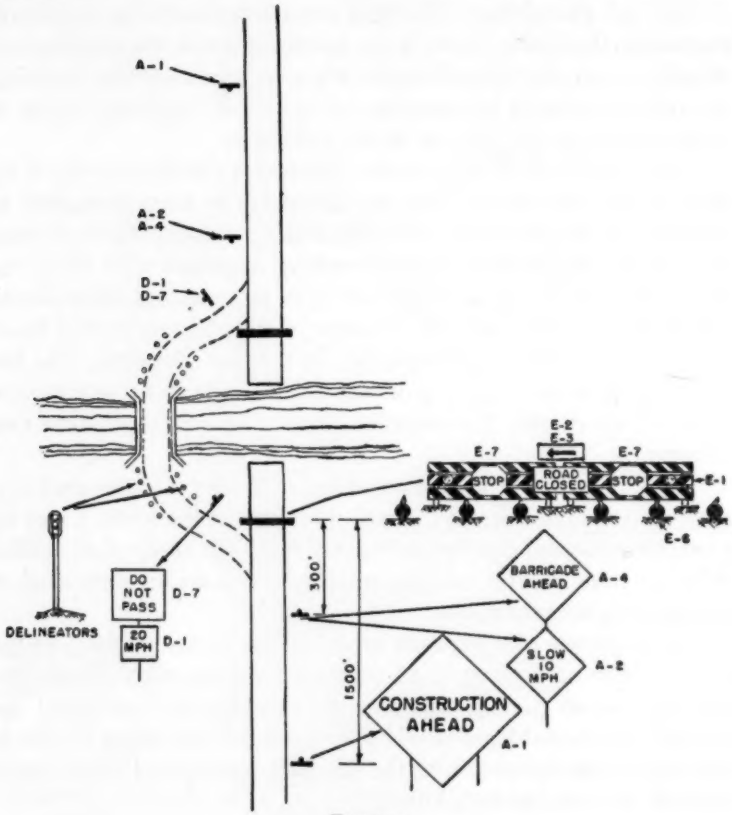


FIGURE 2.

The temporary route should be carefully posted as a detour, with temporary route numbers. Any additional information, such as safe speed limits, low clearances, bridge capacities, crossroads, bumps, dips, etc., which may guide and warn the motorist is an essential part of the detour itself. These postings are, normally, the responsibility of state, county or local authority. Marginal delineators or guard rails may be required, also.

In the case of extended detours under discussion, periodic patrolling may be necessary to enforce regulations, to check on the legibility of signs, to ascertain the adequacy of lighting and to detect any surface irregularities or hazard which may require correction.

Figure 2 shows a temporary run-around detour, as required in

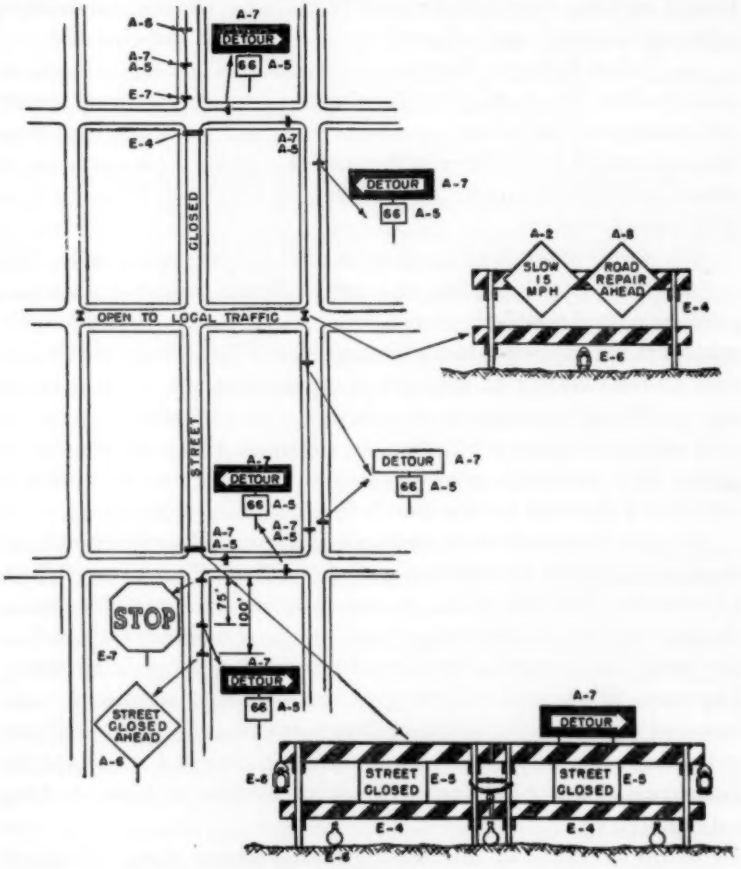


FIGURE 3.

cases of pavement collapse or wash-out, curve elimination, bridge failure, grade crossing elimination, and other relatively *short length* road projects.

The principles discussed for traffic-control measures for ap-

proach, extremities and detour route apply equally on these short-length projects. Contractors tend to be negligent with regard to the short-length detour routes, which are, normally, their responsibility entirely. Experience indicates the majority of serious and costly traffic accidents occur on short detours which have poorly maintained surface, steep grades and insufficient widths, particularly when the traveled way is shared by the contractor's equipment.

2. *Urban Detours:* Figure 3 shows a typical multiple-block detour in cities. The traffic control measures required at the approach, job extremities and along the detour route differ considerably from those discussed in rural areas, because of a greater concentration of street intersections, traffic and parking, as well as local rather than state jurisdictions.

(a) *Approaches:* Because of the usual block arrangement in cities varying from 500 to 300 feet in length, advance warning of detours must be posted relatively close to the job extremities, usually in the middle of the adjacent blocks. Posting a black on yellow reflectorized sign, to read STREET CLOSED AHEAD, approximately 100 feet in advance of the intersecting street preceding the point of closure, would give sufficient advance warning. In addition, a Detour Marker together with any Route markings should be posted at least 75 feet in advance of the same intersection before the point of closure.

(b) *Job Extremities:* At each end of the road closure, a barricade constructed across the roadway and sidewalks, will serve to exclude all vehicular and foot traffic. In urban areas, horse-type barricades chained together to simulate a fence, are more commonly used than the fence-rail barricade, because of greater flexibility in handling. Alternate black and reflectorized white strips combined with lanterns, reflectorized shields and flare pots will increase the visibility of barricades to motorists. Any signal heads mounted at or near the job extremities should be made either inoperative or show a flashing red signal face.

At the entrance of intersecting minor streets along the closed street, a secondary horse-barricade should be erected to permit limited access by local vehicles and pedestrians to their residences or business. Any major cross streets should be closed off completely on either side of the street under construction, and posted for detour as described above.

(c) *Detour Route:* A detour in congested urban areas must necessarily be as direct and open as possible. It is important, if traffic demand warrants it, that the detour street selected duplicate the street under construction in number of lanes, direction of movement, speed limits, accessibility, etc. It should parallel the closed street and be clearly posted as a Detour with such Route numbers as may be necessary. Single block detours are also common to urban areas, and the types of traffic control measures described for multiple block detours are applicable, except in lesser degree.

II. Major or Minor Road Repairs—Traffic Maintained

Many highway improvements must be carried out from beginning to end without interrupting the daily flow of traffic. It then becomes necessary to keep public vehicles outside of work areas, yet at the same time guide them safely and smoothly through the project. In addition, construction schedules must be maintained by the contractor and his personnel must be protected.

Major road repairs may include reconstruction of pavement, laying of sewers or cable, extensive street widening and other operations which must be completed in parallel stages to permit continuous traffic movement.

Minor repairs, typical of urban areas, may include road patching, electrical emergency, pole replacements, cable pulling, excavations, lane marking and any number of short time projects.

Because the degree of exposure and potential liability increase greatly when public traffic and construction activities mix on the same right-of-way, special precautionary measures are required. The public must be informed at all times of conditions ahead. The contractor or superintendent must plan operations and movements of construction equipment with extra care and establish limits of work areas with caution so that traffic lanes for public use are not obstructed or made hazardous.

The necessity for maintaining traffic movement through major or minor repair projects requires that traffic control measures at approaches and job extremities and throughout the work area be frequent, clear and strictly enforced. Such controls are designed not to eventually exclude traffic, as at detours, but to lead it gradually up

to the work limits, steer it into its proper portion of right-of-way, and guide it without undue delay or exposure through the entire project.

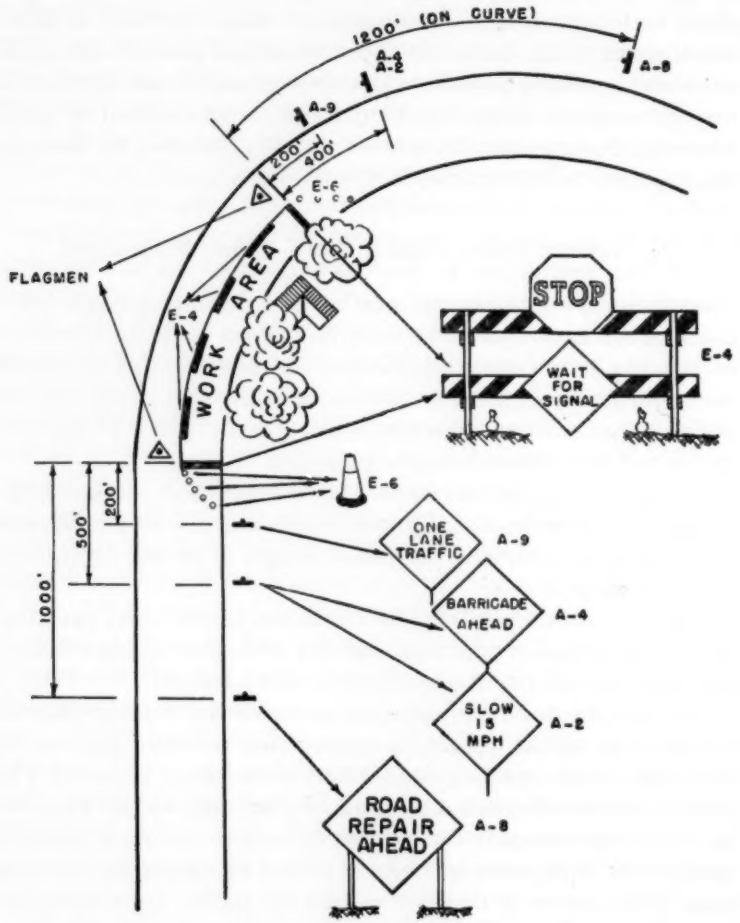


FIGURE 4.

Rural Repairs: On rural roads or marginal arteries, the pattern of traffic control will be similar to that illustrated by Figure 4 representing major repairs.

(a) *Approaches:* Night and day, warnings must be clearly visible

to a driver approaching a section of road undergoing major improvements, advising him of conditions ahead at a glance.

At least 1000 feet in advance of construction on straight stretches and 1500 feet in advance on curving roads—an oversized diamond-shaped sign should be posted on the right side of the road facing the driver bearing the legend, ROAD REPAIR AHEAD.

A second sign should come into view 500 feet in advance of the repair area to read BARRICADE AHEAD, together with a SLOW TO 15 MPH sign. The final sign is placed 200 feet in advance reading ONE LANE TRAFFIC, PAVEMENT NARROWS or some other warning of reduced road width.

(b) *Job Extremities:* Traffic streams approaching the project are steered into each end clear of the work areas with some form of physical channelization. Pavement transitions may best be indicated by setting up multicolored reflectorized rubber cones, or lining up rows of mounted flags and lighted flare pots.

This channelization or diagonal transition should be at least 150 feet in length for rural areas, terminating at the partial barricades positioned at each end of a job.

Closing off the work areas can best be accomplished by the placing of horse-type (or A-frame) barricades, at each end and along the side exposed to traffic. Again, diagonal striping, reflectorization, and lighting of the barricades is important. A standard "STOP" sign combined with a "WAIT FOR SIGNAL" sign should be mounted on or just in front of the barricades if the right-of-way paralleling the work area is reduced to a single lane requiring alternating movements under flagman control.

If the pavement is to remain reduced to single lane operation during night hours, flagman control (with lighted torches) must necessarily be maintained. If the right-of-way paralleling the work area permits vehicles to pass safely, advance signs should read KEEP RIGHT combined with a SLOW TO 15 MPH sign.

(c) *Work area:* Constant guidance and protection are necessary to prevent accidents from occurring on the section of roadway reserved for public traffic. In addition to separating the work area from the traveled way with horse-type barricades, warning signs may be required such as a SPEED LIMIT sign, TRUCK CROSSING, ROAD MACHINERY AHEAD, DO NOT PASS, STOP, FALLING ROCK, NO PARKING, etc.

Urban Repairs: While improvements on city streets may be quite extensive, the work must progress block by block with as little traffic interference as possible. Therefore, any traffic-control measures adopted would apply to both minor and major repairs confined within a city block.

The intensity of demand for street space by traffic units in the central business district necessitates careful planning to fit work-area limits into the complicated pattern. The movements of buses, trucks, passenger cars, taxis and pedestrians are usually so intermingled as to represent a composite traffic mass surge which reaches peak proportions between 7:30 and 8:30 a.m., between 12 noon and 1:00 p.m. and between 4:30 and 5:30 p.m.

In establishing proper protective and traffic control measures at a given job site, consideration must be given to street widths, directional movements, curb parking, truck and bus loading zones, pedestrian facilities, commercial frontage, and other work operations in order to keep interference and hazard exposure to a minimum. In general, considerable cooperation is obtained during urban repair work. City officials will reroute traffic, eliminate parking and institute other emergency measures as may be required; merchants will make alternate arrangements for pickup and delivery of their goods; and pedestrians will accept certain limitations as reduced sidewalk widths or relocated cross-walks. Motorists will usually obey temporary restrictive regulations on speed limits, parking, and reduced right-of-way. Such cooperation is not always guaranteed, and even when obtainable, it does not lessen the responsibility of the contractor and public works or utilities superintendent to protect the public and his own employees from possible harm.

The number and type of protective and traffic control devices necessary for an urban repair project will depend upon the location, traffic density, size of work area, equipment to be used and local conditions contributory to hazard. Generally, the approach and job extremities are so closely merged that traffic control measures can be applied interchangeably. In this discussion, both the approach to and extremity of urban repair projects will be treated as one area of application, with the work area discussed separately.

(a) *Protection Layout Patterns:* Figure 5 illustrates general patterns of traffic protection and control for minor repairs at various

locations along a typical city block, with each pattern including the approach, job extremities and work area. It should be noted that the work area is to be kept small to minimize interference with traffic and rearranged and shrunk as quickly as possible, especially at intersections.

(b) *Installation of Control Devices:* Traffic control devices—signs, barricades, lights, etc.—must be easily portable to provide the flexibility required to shift work areas quickly and form an adequate protective pattern around the job.

Signs should be held to a minimum to prevent confusion. High level portable battery flashers, self-revolving blades or flags are especially helpful in attracting the attention of approaching motorists to a warning sign.

The most appropriate advance warning is one reading DANGER, MEN WORKING, or ROAD REPAIR AHEAD. These are best located about 75 feet in advance of the work area if possible, or at job extremities.

To steer traffic around the project some form of channelization is necessary. As the protective patterns of Figure 5 indicate, the work area should be tapered off at the end where traffic approaches. Such channelization can be accompanied with rubber traffic cones, flags on stanchions, or horse-barriers. Pavement line painting is impractical in city work for channelization since it defeats the requirement of flexibility. Smoke pots are sometimes used to establish a limit line but should be raised to a height of three or four feet by drums. On small jobs the tool truck or cart should be placed at the traffic approach end of the work area as further protection. Flashing lights afford the best approach warning to vehicles.

The work area is separated from vehicular and pedestrian traffic by simple horse-barriers, pipe rails, or traffic cones. Barriers should be set up along sidewalks prior to the repair work. In the case of deep excavation, fence barricades with three or four wide rails are the best separation. The lower rail set at street level can serve as a toe-board for the spoil bank.

If the work area occupies at least one traffic lane so that approach traffic from either direction cannot pass simultaneously, a flagman or police officer should be assigned to direct alternating movements of traffic from each direction.

Accessory portable signs may facilitate traffic movement around

a work area, and these include ONE WAY arrows mounted at the approach intersection, or KEEP RIGHT or LEFT or ONE LANE TRAFFIC, DANGER signs may also be required along the work area at a point

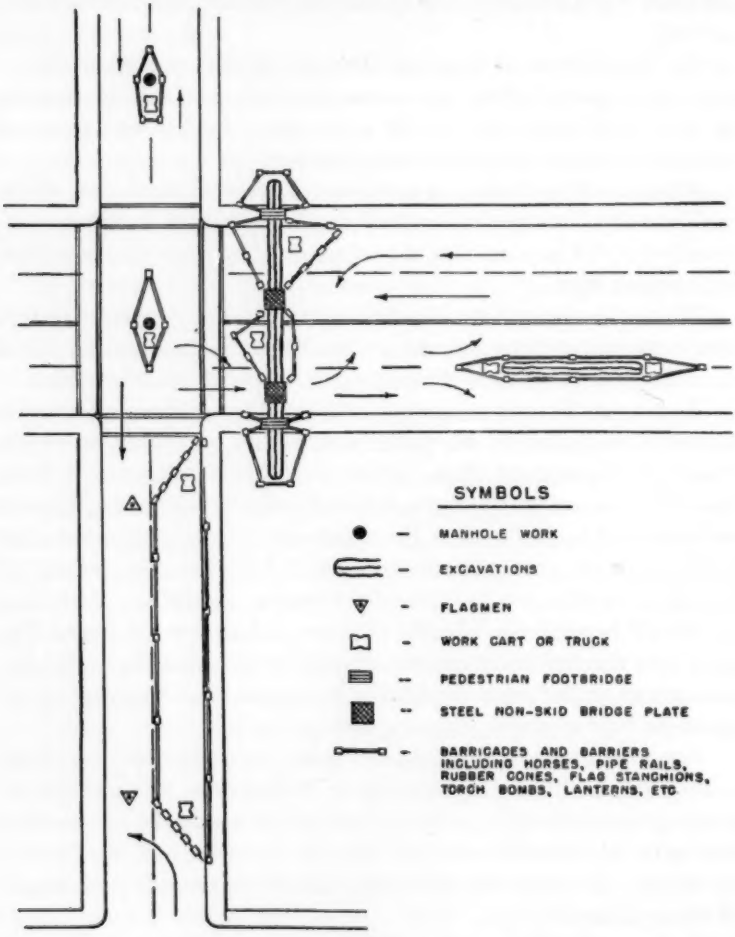


FIGURE 5.

where equipment or materials may encroach on the traveled way at intervals.

When the work area cuts across traffic streams as in Figure 5,

FIGURE 6. Pedestrian Footbridge.

special provision must be made to provide traffic lanes across any excavation or differences in pavement grade. Steel plate or heavy planking can be used to bridge any street opening to permit traffic to cross without interference to operations or exposure to workmen.

On paving jobs, care must be exercised to eliminate grade differentials on the traveled way. Sharp differences between new and old pavements, or raised manholes must be clearly indicated by reflectorized delineators, or barricaded and lighted to prevent possibility of being struck by vehicle wheels. A recent suit totalling $50,000 arose from a claimant injured when the front of her car dropped four inches due to differences in street levels, and the front axle engaged a raised manhole.

The most common source of damage claim arises from pedestrians walking near or through a work area. Definite measures must be taken to provide separate facilities for pedestrian movements. As Figure 6 illustrates, even the smallest excavation or obstacle must be made hazard-free. Barricades, footbridges, adequate illumination and other special precautionary measures can be applied to lessen liability. In addition to keeping tools, ropes, pipe, and spoil banks away from pedestrian traveled ways, shields should be erected to reduce possible injury or damage from flying stone, hot asphalt, welding sparks or other hazardous materials and operations.

III. Maintenance

Despite the most comprehensive use of traffic signs and devices on road building jobs closed to traffic, accidents may occur. The major reason has been traced to motorists' misunderstanding the intent of a posted sign, resulting usually from illegibility, obsolescence, or improper location. In rural areas, particularly, an accumulation of dust and grime can reduce the reflectivity and legibility of a sign to near zero visibility. Also, a cheaply fabricated sign will deteriorate quickly from weathering, and unless mounted properly on posts, even the best fabricated sign may be loosened and fall.

This fact should emphasize the need for periodic maintenance of all traffic signs and devices used on the approaches, job extremities and detour and work area routes. Unfortunately, many contractors bid on maintenance of traffic as a lump sum item at ridiculously low

prices that do not cover the barest maintenance and protection necessary.

Equally important is the relocation of signs as needed to keep pace with job completion. As each section of a road is opened for traffic, and the point of job extremities moved ahead, the informational and warning signs should be moved accordingly. Nothing breeds contempt for posted signs more quickly than false information to a motorist. If a posted sign informs him that the detour begins 800 feet ahead he will slow down expecting to make the turn. However, if the detour turn is advanced another 5000 feet, without advance signs being revised, considerable ill-will can be created.

In addition to regular sign-maintenance, the traveled way en route should be checked periodically for surface irregularities, slides, and other potential hazards to the public. A trustworthy, reliable man provided with a pickup truck should be assigned to maintain and relocate and check signs, place flares, delineators, and visibility aids, and check hazards throughout the entire job, recording the time of inspection and signing his name.

Most signs and barricades can be easily constructed by the contractor or superintendent from his own stock. The important consideration in this regard is that the shapes, sizes and colors recommended herein be followed, since they represent the most widely-used sign types with which the majority of motorists are familiar.

Under conditions of darkness, storm or limited visibility, proper lighting of signs, barricades, work equipment, and hazard locations, is of vital importance to avoid possible damage claims. Signs, barricades and other control devices should be painted in distinctive contrasting colors with the lighter color reflectorized to catch any source of light. Reflector buttons are commonly used to emphasize sign lettering, to outline barricades, or form edge delineators for roadway or work areas.

Oil lanterns and pot torches emphasize danger points, but alone provide inadequate illumination. Work areas and other areas of potential hazard require a high degree of illumination by means of flood-lights or other superior luminaries. Police or flagmen directing traffic should wear reflectorized crossed belts and carry electric flashlights.

IV. Enforcement

Enforcement of regulations established—speed limits, bridge capacities, directional movements, parking, equipment clearance lights, placing of flares—is of vital importance to accident prevention. Signs and barricades in themselves have a limited effect on eliminating accidents. Enforcement through police action of some type is definitely necessary, either with flagmen or authorized police officers.

Enforcement must be firm but courteous and uniform in application and flexible to meet changing conditions as work proceeds. The contractor's personnel must understand that the public is receptive to fair treatment and willing to accept inconveniences caused him by road improvements, provided every attempt is made to keep such inconveniences to a minimum.

Enforcement is especially needed on sections of roadway under major or minor repair but open to public travel. Flagmen, police officers or watchmen should be assigned to direct traffic as necessary, and in the case of alternating one-way movements over long stretches, they should be provided with visual or audible means of communication with each other, to avoid directional conflicts; on complicated or hazardous routes a pilot lead car is the best means of guiding alternate opposing traffic streams through the work area. A simple means of communication is the passing of a baton by the last motorist in a given direction to the flagman handling the opposite direction of traffic flow. Specific rules for proper flagging operations are available from State Traffic Commissions, State and Local Police, Insurance Carriers and other sources.

V. Materials and Equipment Control

Good housekeeping of materials and controlled supervision of equipment movements will minimize damage claims rising out of injury to persons and destruction of property. Operational negligence is responsible for more than one-half the accidents reported on road jobs. Trespassing on abutting private property, haphazard and unplanned storage of materials, improperly parked equipment, unsafe operational speeds for prevailing conditions, and inadequate traffic control measures are cited over and over as contributing to accidents.

Preliminary Planning: To be most effective, accident prevention should become a definite part of advance operational planning and have the backing of top authority. Consideration must be given to:

1. Establishing storage areas and limits for construction shacks, tools, forms, scaffolding, reinforcing steel, aggregates, cement, asphalt, blasting supplies. tarpaulins and all other contractor's items.
2. Proper disposal of trees, stumps, brush and discarded material in dump areas away from private property or a traveled right-of-way.
3. Preparing low-exposure routing for construction equipment on the job site, between construction area and batching plant, borrow pit, rail head or other supply points.
4. Selection and training of equipment and vehicle operators through a sound, well planned program.
5. Traffic Control devices such as signs, barricades, channelization, night illumination and trained watchmen to protect the public and assure job traffic control.
6. Laying out off-street parking areas for employee vehicles and contractor's equipment.

Application of Procedures: Effective, impartial supervision can be obtained only when supervisors and foremen are aware of the need for strict and continuous application of the correct operational procedures. These may include:

1. Established driving speeds for equipment, loaded and empty, on grades, curves and tangents.
2. Preventive maintenance and inspection of equipment on a regular, periodic basis.
3. Making equipment inoperative and secure during temporary shutdowns on a job site.
4. Use of vehicle clearance lights, flare pots and other aids to visibility during hours of darkness.
5. Erection and maintenance with all the necessary flexibility and regularity of signs, barricades, and other traffic control devices for guidance and complete protection of the public.
6. Elimination of dust, mud, slides, holes and obstacles on areas traveled by the public.
7. Removal of materials, jobsite buildings, batching plants, signs and other elements after completion of the job.
8. Safe job performance guarantees by sub-contractors—for added protection against damage claims.
9. *Prompt reporting* of accident involving compensation and public liability.

A large percentage of equipment collision and loss of control accidents, together with instances of vandalism have occurred during periods of job shut-down. Principal causes of such accidents are neglect to make stored equipment inoperative, promiscuous storage of building materials or waste off the traveled way, lack of sufficient and properly placed flare pots and other visibility aids during hours of darkness.

VI. Completion or Suspension of Project

One damage claim for $50,000 resulted when the claimant sustained a fractured skull, elbow, and jaw in a motorcycle collision with a paving machine. The contractor is charged with failure to keep approaches properly barricaded and not properly lighting the equipment at night time.

Another contractor was charged with negligence in his failure to provide a watchman, guard or any form of protection or warning at a creek excavation. In this case, boats and rafts used by the contractor in conjunction with the new bridge construction constituted an "attractive nuisance" to children on the weekend. The body of a 10-year-old-boy, playing in the boats, was found Monday morning at the job site.

Regulations established relative to correct operational procedures to assure effective accident prevention should extend to sub-contractors. Safe job performance by sub-contractors will serve as added protection to the general contractor against possible damage claims, since the contractor may be held liable for the negligence of his sub-contractors.

A case in point: After laying a new road, the contractor hired a sub-contractor to finish the shoulders, the road being opened to traffic. The sub-contractor was negligent in correcting or warning by use of delineators or LOW SHOULDER signs against the three-inch differential between the top of the new road and the adjacent shoulder. During a week-end shut down of the job, a motorist lost control of his car which struck a tree. He was killed. The right wheel left the pavement and became rutted in the low shoulder. A $100,000 jury award was made in favor of the estate of the deceased. In another case, two sub-contractors contributed to an accident through their negligence; one being an excavating company, and the other a detec-

tive agency. The excavating sub-contractor was removing gravel in his own trucks from a borrow pit at night for delivery to the road builder. The detective agency was responsible for direction of traffic at the point where the gravel trucks entered and left the main highway. Two automobile passengers were seriously injured when their vehicle struck the rear of a gravel truck just entering the highway from the gravel pit.

The detective agency was charged with failure to give advance warning or direction and to provide adequate illumination for users of the public highway. The excavating sub-contractor was charged with the excessive depositing of mud and dirt on the highway and creation of dusty and dangerous low visibility driving conditions.

Upon completion and relinquishing control of a road building project, prompt removal of job site structure, equipment, signs, aggregates, and other contractor's items will eliminate possibility of vandalism, personal injury or property damage. Any area opened for public vehicular or pedestrian travel should be cleared of stumps, rock and other waste or discarded materials.

In urban repair work, extra precautions are necessary to eliminate accident exposure during non-working hours. Excavations must be either temporarily covered or completely fenced off with proper lighting from sundown to sunrise. In areas of concentrated traffic, police control may be necessary for some hours after the work ceases.

Joint Highway Research Project At Purdue University

HAROLD L. MICHAEL

Mr. Michael is Assistant Director of the Joint Highway Research Project at Purdue University and is also an Assistant Professor of Highway Engineering. He administers and supervises research on highway materials, design, and planning and actively directs the research in traffic and highway planning. Mr. Michael has directed traffic studies in Indiana cities in cooperation with the State Highway Department of Indiana. He is also Director of the Extension activities in traffic engineering at Purdue University and in this capacity makes numerous talks in cities throughout the state. He is a member of the American Society of Civil Engineers, the Institute of Traffic Engineers, the National Society of Professional Engineers, the Highway Research Board, and others. Mr. Michael is a registered Professional Engineer in Indiana.

HIGHWAY transportation is one of our largest, most critical domestic problems. The need, demand, and desire to supply adequate highway facilities indicate enormous effort in the next decade to provide facilities to satisfy the requirements of highway transportation. Planning and operating this vast system of highways, to say nothing of the construction, will be a tremendous job.

Research as a major tool in supplying the knowledge to develop this highway system is immensely important. Great advances in technology in recent years can be directly associated with the areas of research and development. Every successful industry recognizes the importance of the search for new products, new techniques, new uses, and the quest for improvement in their present commodities. Civilization today results from research in the past; civilization tomorrow will result from research today.

The demand for transportation and its importance to national and local economy require those in the field of transportation to provide and maintain a system that is adequate, efficient, economical, and safe. This is a challenge that needs the maximum energies of every highway worker and the cooperation of every citizen. Pro-

viding and maintaining such a highway system is not a closed and finished business. We do not know all there is to know about highways. Great areas of the relatively unknown remain in this field, and through research these unknowns are being reduced year by year and day by day.

It has been said that highway development has not paralleled the development of the motor vehicle. The truth of such a statement should only indicate that someone must search the harder for more lasting methods of construction, for more economical maintenance techniques, for more efficient traffic operation, and for safer means of travel.

In recent years, greatly increased highway travel and the vast amounts of money required to construct modern highways have brought about a greater emphasis on highway research and development. The federal government expends considerable funds on studies and plans for our highway system and is constantly developing facts valuable to the highway engineer. Many state highway departments, universities, industrial and commercial companies, and national and local organizations have contributed materially to the know-how that enabled this country to have the best transportation system in the world.

Organizing the Project

The state of Indiana has contributed a share, for research has always been one of the state highway department's considerations. In 1936 this resulted in the creation of the Joint Highway Research Project at Purdue University. Although the budget for the project remains only a fraction of one percent of the total state highway budget, research on a variety of highway problems has been completed or is in progress. The project pioneered in state highway-university cooperation, received national acclaim, and served as a blueprint for similar organizations in numerous states.

In a few words, the legislative act authorizing the Joint Highway Research Project specifies that the allocated money is to be expended for conducting highway research, holding the annual Purdue Road School, for disseminating highway information, and for highway extension. It operated during its first year as an agreement between

the director of the Engineering Experiment Station of Purdue University and the chairman of the State Highway Commission.

In 1937 it was established by an act of the state legislature which permitted the State Highway Commission to allocate $50,000 annually to Purdue for highway research. The University provides the laboratory and office space and administers the project through the Engineering Experiment Station. The project is guided by an advisory board consisting of six members of the staff of the School of Civil Engineering and five engineers of the Indiana State Highway Department. This board approves, and often suggests, the research projects it believes to be of greatest value to the citizens of Indiana.

Basic Objectives of the Project

The project has been expanded in recent years because of the critical need for additional research and the acknowledgment of that need by a 1949 act of the state legislature increasing the project's permitted maximum funds from $50,000 to $150,000. Although substantially increased, this allotment for highway research, even when added to that performed by the state highway department as planning and development, is far less than a progressive and successful private industry of equal size would deem advisable.

With the available funds, however, a great deal has been accomplished. The basic objectives of the project are to:

1. Make basic studies of highway materials.
2. Facilitate economical design, construction, and maintenance of highways.
3. Investigate traffic and safety.
4. Provide advanced instruction in fundamentals of highway engineering.
5. Provide practical experience in construction and maintenance procedures.

To carry out these objectives a staff has been organized and divided into eight separate sections:

1. Soils
2. Concrete Materials and Rigid Pavements
3. Bituminous Materials and Flexible Pavements

4. Airphoto Interpretation
5. Chemistry of Materials
6. Economics, Administration, and Finance
7. Traffic and Safety
8. Structures

Each of these operates from a laboratory in the School of Civil Engineering and uses the highway facilities of the state, a private test road, and laboratory data as the source of research material.

The staff at the present time (July 1955) consists of forty-four full- and part-time personnel—engineers, a chemist, a statistician, an engineering geologist, an economist, twenty-five graduate assistants studying for an advanced degree—and a clerical and service staff of nine.

Contributions of Highway Research

The question occasionally arises as to benefits the state highway department receives from the money it contributes. In other words, is it making a wise investment?

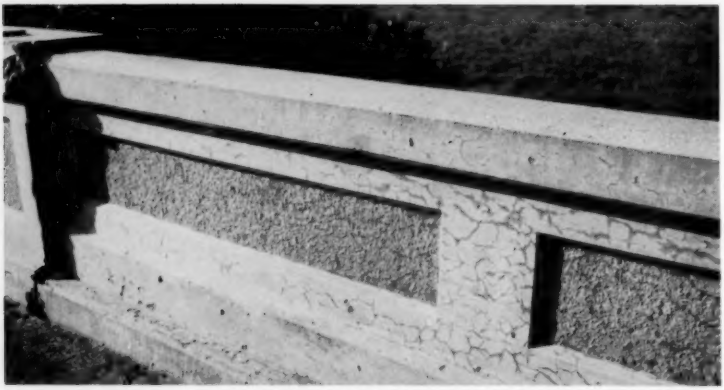
Several studies each produced results which have been and are currently saving the state highway department amounts of money several times greater than the annual budget allotment to the project. Numerous studies have produced valuable monetary results for the state highway department and for all highway groups in the nation.

Perhaps the best way to appreciate the value of the research in the last few years is to discuss briefly some of the more important projects completed since 1950 or currently in progress.

Research in Soils: As more and more consideration has been given to pavements' foundation material, research in this area has become extremely important. It is of course well known that a pavement cannot be economically and adequately designed unless the engineering characteristics of the soil on which it is to be laid are known. Not only is information needed about the surface soil but also for foundations of large structures knowledge of the subsoil to a considerable depth is required. Research in the soils area included the

Field testing of traffic paints for the Highway Department shows wide range in quality of the paints tested.

Costly delays occur frequently at railroad grade crossings. Traffic problems of this kind are studied by the Joint Highway Research Project in several Indiana cities.



Deterioration of a bridge structure. Note the pattern cracking—a sure sign of deterioration.

These views show effect of coarse aggregation performance of concrete pavements, and contrasting performance on opposite sides of a construction joint at which the coarse aggregate was changed from G–15 to 791G. All other materials are the same for both sections of pavement.

development of resistivity methods for sub-soil exploration. Such a method is rapid, comparatively easy, quite accurate, and often more economical than the coring methods generally used. This study developed procedures for using this method in Indiana and provided the bridge department of the state with design data for several sites.

Triaxial tests for soils from a test road and the performance of C. B. R. tests on soils at other test roads were also conducted by the soils group. Development of pavement design procedure for flexible pavements using the triaxial tests and development of procedures for calibrating soil moisture cells received considerable study and produced valuable design information. The rigid and flexible pavement surveys, made periodically, were again continued by the resurvey of the pumping of rigid pavements conducted last spring.

The project also performed strength tests on soils for the state highway department and plans to perform tests for bridge foundation design. Tests of soils in conjunction with the soil-mapping program are also an activity of this area.

Research in Concrete and Concrete Pavements: The premature deterioration of some concrete pavements and structures for many years was a source of concern to all in the highway field. In Indiana the field of performance of concrete containing certain aggregates was noted during studies made prior to 1950. Since that date laboratory studies of concrete durability indicate that the freezing and thawing test for concrete is the best method of determining aggregate durability.

Development of a standardized acceptance test for aggregate is currently underway as a result of the findings of this study. Another study demonstrated that deleterious particles in gravels can be separated by heavy media techniques. Work is currently underway to establish proper specific gravity and percentage values for use in acceptance testing of aggregates.

Surveys of the deterioration of structural concrete demonstrated that the design and exposure conditions of structures are primary factors in their performance. Preliminary results justified the requirement of air entrainment in all concrete used in bridge superstructures and indicated the necessity of minor design changes. Huge

savings are due to the state, through increased life and decreased maintenance, on structures built after the recommendations of this study were adopted.

Research in Bitumens and Bituminous Surfaces: Projects in bitumens included studies on the effects of the type and grading of aggregate, the type and consistency of bituminous material, the amount of bituminous material, the density of the mixture, and the rate of loading. Considerable study was made of the cause of rutting in high-type bituminous pavements constructed on silty-clay soils.

In bituminous mixture design, specific mixture stability problems were studied and comparisons made between Marshall Test results and unconfined and triaxial test results. A better understanding of the Marshall Test resulted and permitted a more intelligent application of Corps of Engineer design procedure to Indiana AH Type B bituminous concrete.

A recently completed study of the effect of aggregate shape on the stability of bituminous mixes may be expected to lead to specification requirements for crushed pieces in gravel aggregate, on a more realistic and economical basis than has been true in the past. Rutting in bituminous concrete overlay under severe traffic conditions is receiving major attention now and should lead to specific recommendations for changes in mixture design that will resist the increased demands of traffic.

Traffic-paint studies, conducted under actual traffic and weather conditions, materially benefited the state directly and almost immediately by demonstrating the most economical traffic paint to apply.

Research in Airphoto Interpretation: The planning of any engineering project requires information on many factors before location or design can be accomplished. Collection of the necessary data is time-consuming and expensive if they must be accumulated in the field by engineers. In many instances such collection is prohibitive. The use of aerial photos to supply much of the required information has become common practice and has resulted in huge savings of time and money.

The airphoto department of the project was a leader in this

field and developed interpretation techniques and procedures recognized throughout the world. One of the purposes of this department was to develop methods of extending airphoto use to other areas. As an example, photos were taken by the project for use in several traffic studies conducted for the location of highways. The use of aerial photos in developing information on areas for bridge sites promises to promote a more rapid and economical determination of the detail required for bridge design.

The important contribution to the state highway department, however, is the continuation of soil and drainage mapping programs. The engineering soil mapping now covers about one-third of the state. Selection of routes on the most stable soils was made from airphotos for several state highways, and the location of suitable borrow areas specifically benefited the state on several occasions.

The drainage mapping program is now complete for eighty-six of the ninety-two counties. These maps are extremely popular and provide more accurate drainage and watershed information than is practical by other means. They permitted the wise determination of bridge openings and undoubtedly prevented some washouts and flood damage. In recent months these maps were used for almost all of the drainage planning of the toll roads and were one of the reasons that the plans for these facilities were rapidly completed.

Research in Chemistry: Since 1950 this relatively small unit of the project has prepared a rather extensive bibliography of the literature available on line-soil stabilization and has done considerable research on the chemical reactivity of aggregate, the porosity of aggregates, and the thermal diffusivity of stones. Many of the aggregates of the state were fortunately found to have little alkali-reactivity, and improved test methods for porosity and thermal diffusivity will probably develop from research on these properties.

Heavy fall precipitation followed by sub-freezing temperatures was shown to be an important factor in spring break-up. This conclusion followed a study of weather conditions in Indiana and correlation with our surveys on spring break-up.

Research in Traffic and Transportation: In traffic engineering and highway planning, numerous valuable studies have been com-

pleted or are being made. A study of the uses, effects, and control of by-passes received nation-wide recognition and indicated the methods which should be employed in locating and maintaining these facilities for maximum use with maximum benefits during their full life. A factual determination of the number and type of motorists who use a new facility also proved valuable in determining the use that would be made of other suggested highways, and promoted wise planning of the proper facilities.

During the last three years, the project cooperated with the metropolitan area Traffic Survey Unit of the state highway department in the planning, conduct, and analysis of comprehensive traffic surveys in seven cities of Indiana. Three of these studies were made almost completely by project staff and provided adequate information for developing a complete highway, street, and parking plan for each of these cities.

The data collected from these surveys were used to develop new methods and procedures for collecting and analyzing traffic information that provides more efficient, economical, rapid, and thorough use. Some of the more important of these were the use of sampling procedures in origin-destination surveys, the adaptation of roadside interviewing to inside-the-city use, a comparison of the postcard and home-interview methods of origin destination surveys, and the determination of parking demand.

A comprehensive study of the characteristics of traffic was also completed and provides valuable information for the highway planner and designer. A continuing traffic speed study has been underway for the last sixteen years. This record of speed trends has proved valuable to engineers, administrators, enforcement officials, and legislators.

Another current project is a study of the effects of the "scramble" system traffic light for pedestrian control. This light stops all traffic for a portion of the cycle while only pedestrians cross, thus minimizing pedestrian and vehicular conflicts.

Research presently being planned includes an attempt to evaluate desired traffic movement data from some source other than interview, such as from land-use, driver characteristics, and population habits. Also planned is a study of the factors affecting the obedience of drivers to stop and slow signs.

A very important "Needs Study of Indiana State Highways" in cooperation with the state highway department will include an inventory of all state highways; an historical and economic study of highway development; road use, operational, classification, financial, and administrative studies of the state highway system, and development of a program of improvements for the state highway system.

This study is intended to enlist public understanding of the highway problem and to provide state highway authorities with a scientifically-determined plan of attack that will guide the construction, maintenance, and operation of an adequate, efficient, and economical highway system.

Research projects have also been discussed in crash-injury research in cooperation with the Indiana State Police and the Office of Traffic Safety. This cooperation resulted in the production of a movie on this subject, available to the public. It is entitled "For Whom the Traffic Toll," thirteen minutes long in black and white. Other projects include safety belt research, design of vehicles to minimize injury in crashes, and a study of the causes of accidents.

Within the last year the highway extension activities of the project have been broadened to include traffic engineering and highway planning. A unit known as Traffic Engineering Services provides advice on these subjects to cities and counties of the state at their request. Current activities by this unit include a classification of county roads in one Indiana county, the dissemination of a comprehensive traffic survey made by the state highway department, and advice on parking and major thoroughfare problems in nine Indiana cities.

The project is also participating extensively in several test road studies of the state highway department. Portions of the study of the merits of bituminous concrete and Portland cement concrete now underway on U. S. 31 near Columbus, Indiana, were assigned to the project. Determination of skidding and lateral placement characteristics of the two types of pavements has been initiated.

For the last several years, we have made skid tests on many pavements in the state at the request of state highway department officials to determine the accuracy of reported information on slick pavements and to evaluate the skid resistance qualities of the various

types of surfaces. A comprehensive study for this purpose was completed in 1955.

At the request of the state highway department, a Road Roughometer was constructed at the University and is used by the project for research studies on comparison of new surfaces and for criteria that will determine the pavements that should be re-surfaced.

Research in Economics and Administration: In this area consideration was given to the status of the several forms of transportation and analyses made of problems on finance, legislation, management and organization, and of the county road problem in Indiana. The need for more effective planning and administration of roads was deemed a requirement of major concern if we are to realize the maximum benefits from our restricted expenditures. A comparative analysis of local road practices in three abutting counties of Indiana, Michigan, and Ohio was made and criteria suggested for establishing county road administration.

In 1952 a study of state highway organization and salary scales of representative states was prepared. It was noted that there are advantages and disadvantages of the several types of highway administration and that there is a significant trend toward changing the functions of commission-type highway organizations from those of administrative character to those of advice or policy-making. It was also evident that an effective policy of wage administration and personnel practices is essential if public service is to compete favorably with private enterprise for qualified engineering personnel.

Studies of the factors affecting highway finance have given a better insight into the highway spending of the past and suggested methods of allocating the great financial costs our highway system presently demands. The classification of roads and streets and the development of rating procedures is currently being studied and will, when complete, provide techniques for the wiser planning of highway construction and maintenance.

A method for identifying county roads and numbering rural homes was prepared and made available to county officials of the state. The need for such a method is well known. This study was made to urge uniformity in the method selected by the ninety-two counties so that identification would be similar throughout the state.

Research in Structures: The project has also assisted the state highway department in various other research. A study of the stresses in bridges was recently completed and reported. On one test road, cooperative research is now conducted by the project, the state highway department, and the Bureau of Public Roads on the relative support characteristics of nine different subgrades. A determination of the stresses in rigid pavements is also receiving attention in this area.

Outside Contracts Bring Benefits

In addition to research carried on with state funds, a large number of studies are simultaneously conducted with funds supplied by other organizations. Although the state has no financial interest in these studies, they invariably reap benefits, for the results are eventually made available to them.

As an example, the present base-course study for another organization is contributing valuable information to the design personnel of the state highway department. The project's research on waterproofing of concrete structures, trafficability of soils, environmental conditions, lime-soil stabilization, calcium chloride stabilization, permafrost, characteristics of frozen soils, moisture-proofing of soils, factors affecting aerial photos, and many other contracted research studies have contributed much information to the field of highways and to the state of Indiana.

The Graduate Program

The graduate program in highway engineering is directly associated with the research activities of the Joint Highway Research Project. The student may specialize in some aspect of transportation, such as traffic engineering, or he may take a general course. In either event, the student is generally able to complete the requirements for a Master's degree in eighteen months and a Ph.D. degree in three years.

Assistantships, requiring the student to work half-time on a research project which he may use for his thesis material, are available to outstanding students. Research of this kind constitutes a major part of the research directed by the project. Occasionally full-time

employment on research and teaching while working towards a degree is available.

Requirements for a Master's program are twenty-four hours of course work and an acceptable thesis, or thirty-six hours of course work. For the Ph.D. degree, requirements include forty-eight hours of course work (including the twenty-four hours used for the Master's), a reading knowledge of two foreign languages or one language and six course hours in some scientific area, and an acceptable thesis.

Students specializing in traffic engineering are urged to include a statistics minor and an economics minor in their graduate program (six credits of each for Master's and twelve of each for Ph.D.). A minor in some other field, such as soils, structures, or surveying, may replace the economics minor.

Courses are available in traffic engineering, traffic planning, highway economics, highway and airport networks, airphoto interpretation, pavement design, and airport design. Courses are also offered in bituminous and Portland cement concrete materials and in chemistry of materials. Each student selects a major professor and is assigned to a faculty committee to guide and advise him.

Almost all of the graduate courses offered in transportation are conducted by members of the full-time staff of the Joint Highway Research Project, and they also supervise the research activities.

Dissemination of Information

One of the most important elements of any research organization is the methods used to release its findings. Research results, no matter how important in themselves, will never provide full benefits unless findings are made available for use. Those who initiated the legislative act authorizing the project wisely acknowledged this fact by providing for the annual Purdue Road School. For forty-one years highway information has been disseminated at this important conference to those in the highway field.

Benefits accruing from the road school are numerous and varied. One important item is the opportunity the school offers for road and street officials and employees to familiarize themselves with materials, methods, and equipment so that they can better serve their constituents. Beneficial exchange of ideas results from the associa-

tion of city, county, and state road men and material and equipment men. An understanding of the other fellow's problems creates harmonious relationships and reacts to the benefit of the state's taxpayers. The Traffic Control Conferences similarly disseminate traffic and safety information and promote the operation of our roads.

Highway and traffic information is also distributed to the various areas of the state through extension activities. Staff members of the project are always available to discuss highway problems and make many trips to almost every city and county in Indiana to view and discuss methods of administration, construction, maintenance, traffic, and finance. A monthly issue of "Highway Extension News" finds its way into the hands of almost every highway official in the state and carries items of value to highway improvement.

Various publications of the project include Proceedings of the Road School, printed after each School and containing the most important material presented; bulletins of the University, published whenever a particular study merits the dissemination of a large volume of data, and condensed results of the most important projects published as reprints from publications where they first appeared. More than 100 such reprints have been made available since the project began—fifty in the last four years. The Directory of State, County, and City Highway Officials is published annually and has rendered considerable service to the highway industry.

The results of many studies are made available to the nation through several staff members on national research committees of the Highway Research Board, the American Concrete Institute, the Association of Asphalt Paving Technologists, the American Society for Testing Materials, the American Society of Civil Engineers, and the Institute of Traffic Engineers. Many of the research activities are released through annual meetings of these organizations and are published in their proceedings. Members of the staff also contribute papers at road schools and highway conferences throughout the nation and to other highway groups.

Manpower Benefits

The shortage of qualified engineers is well known. It causes special concern to the state highway department. In recent years they have

not attracted young men because of the short supply of engineers to fulfill general engineering demands in this technological age, and because of competition for their services. At the undergraduate level it has been necessary to train students in the basic principles of engineering and to leave specialization to summer or part-time employment, or to after-graduation employment, and to advanced study. A major source of engineers for the highway field, therefore, has been students employed by the project on summer or part-time bases and those who elected advanced study in the field of highway engineering.

During the last five years approximately 420 individuals worked part-time in our laboratories. They became thoroughly acquainted with some of the highway research programs. In those five years, fifty-three men received M.S. or Ph.D. degrees in highways and related areas, and twenty-two men of the project staff are doing work in highways, including a research project, for M.S. or Ph.D. degrees.

Most of these men enter the highway field after graduation, and their services are of direct benefit to the highway programs. Part-time employment in the traffic and transportation area of the project resulted in five graduate engineers' accepting employment with the State Highway Department of Indiana after graduation, and in three others' entering the Purdue Graduate School to major in highways. Several other graduates accepted employment with city traffic and street departments.

Analysis of staff men who have received advanced degrees at Purdue in highways or in related areas shows sixty-one employed in twenty-two Universities, twenty-three with consulting and industrial firms, fifteen with highway or city engineering departments. Eleven are foreign with employment conditions unknown, seven are with governmental units, three in the military service, three are classified as miscellaneous, and three died.

This research program in highways and the opportunity for young graduates to engage in this research are major reasons why the graduate program in highway engineering at Purdue has attracted a large number of students (forty-eight in 1955) from all over the world. The research is thus conducted at a reasonable cost by outstanding personnel. Benefits to the state include training of personnel—one of the most important contributions of the project to

the state. If the potential were fully used, it would provide a large number of extraordinarily well qualified engineers for the state.

In addition, the highway programs at Purdue attract many teachers of highway engineering who take teaching leave from their schools to work on advanced degrees.

Summary

In summary, past research has proved that the State Highway Department of Indiana and citizens of state and nation receive large dividends on their annual investment in the Joint Highway Research Project. Many projects enumerated produce yearly dividends that exceed annual expenditures. For example, the bridge deterioration survey resulting in minor design changes and construction techniques materially increased the life of structures and decreased the maintenance. Large ultimate savings will result.

Also, recommendations of the by-pass study resulted in a decision by the state to use the authorized limited access provisions of state statute. Savings from this decision consist not only of savings to the state highway department through establishment of a facility adequate for twenty to twenty-five years instead of for ten to fifteen but in large benefits to motorists, adjoining landowners, and the community.

In short, the knowledge gained from research permits those in the highway field to emerge from the darkness of the unknown into the light of highway progress—and enables the maintenance of a highway system in good condition with inadequate funds. It permits progress forward toward a solution of the Number One problem of the nation. Research enables us to keep Indiana at the top in developing and maintaining a modern highway system. One question remains to be asked:

"Are we spending enough on highway research?"

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